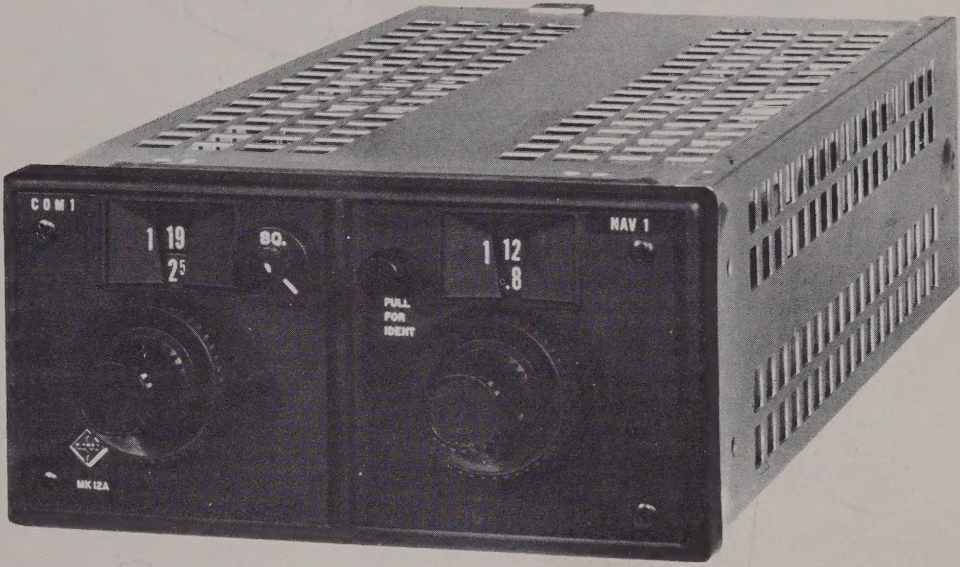
narco


COM 1
1 19
25
SQ.
PULL FOR IDENT
NAV 1
1 12
.8
MK12A

narco MARK 12A
VHF Transceiver

with

NAVIGATION RECEIVER

and

T12MP-12A or T24MP-12A MODULATOR-POWER UNIT

MAINTENANCE MANUAL

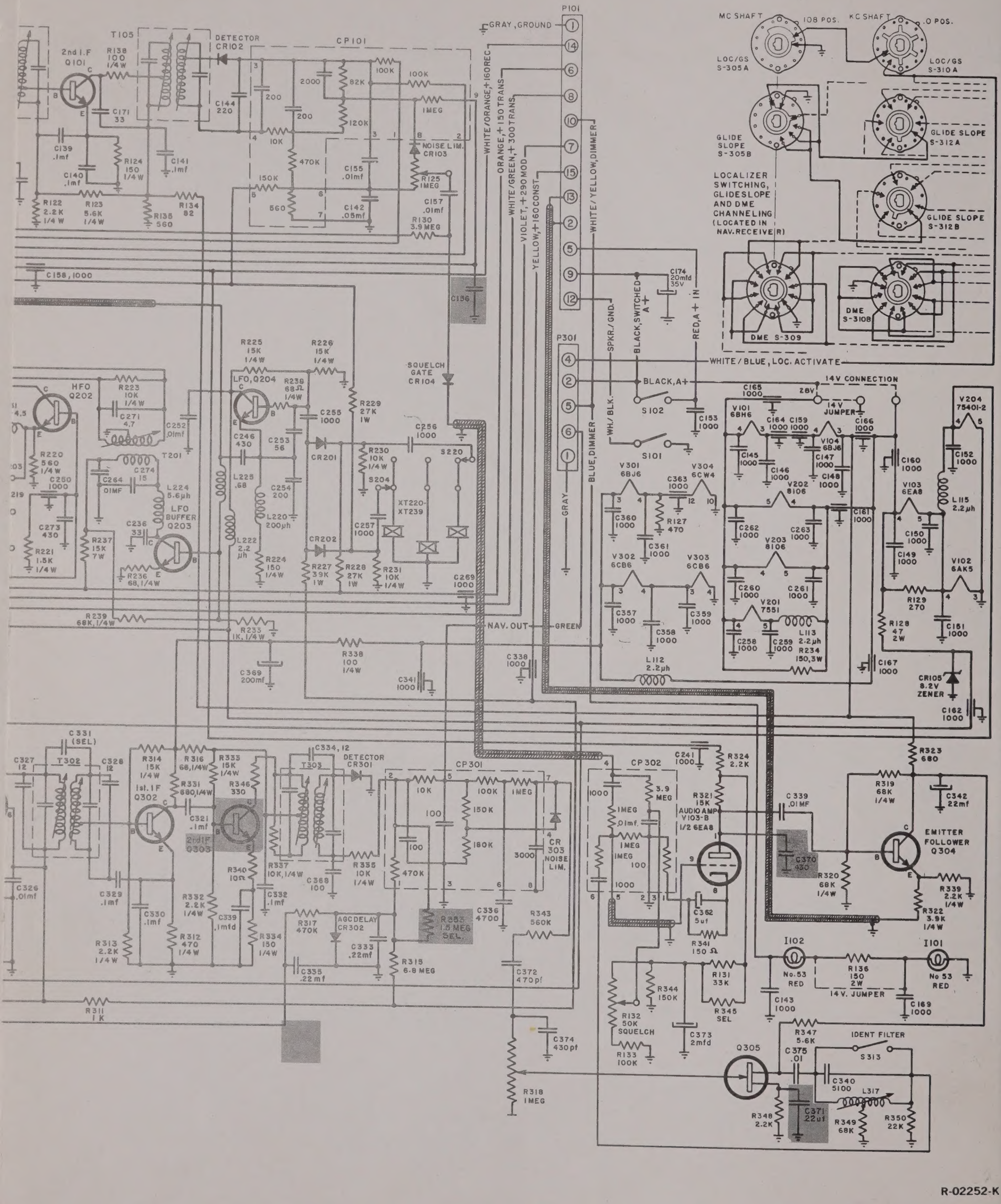
for

CN144-A
CNPA144-A
CNPB144-A

narco AVIONICS DIVISION
NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

April, 1966

Printed in U.S.A.


P101
GRAY, GROUND
WHITE/ORANGE,+160REC.
ORANGE,+150 TRANS.
WHITE/GREEN,+300 TRANS.
VIOLET,+290 MOD.
YELLOW,+160 CONST.
WHITE/YELLOW,DIMMER
BLUE,DIMMER
GRAY
SPKR./GND.
BLACK,SWITCHED A+
RED,A+ IN
WHITE/BLUE, LOC. ACTIVATE
BLACK,A+
WH./BLK.
NAV. OUT
GREEN
P301
S101
S102
C174 20mfd 35V
C153 1000
14V CONNECTION
C165 1000
28V
14V JUMPER
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
GLIDE SLOPE S-312B
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV.RECEIVER)
DME S-310B
DME S-309
T105
2nd I.F Q101
R138 100 1/4W
C171 33
C139 .1mf
C140 .1mf
R124 150 1/4W
C141 .1mf
R122 2.2K 1/4W
R123 5.6K 1/4W
R135 560
R134 82
DETECTOR CR102
CP101
C144 220
200
2000
82K
100K
100K
1MEG
120K
10K
470K
150K
560
C155 .01mf
C142 .05mf
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9MEG
C136
C158, 1000
HFO Q202
R223 10K 1/4W
C271 4.7
C252 .01mf
T201
R220 560 1/4W
C250 1000
C264 .01MF
C274 15
L224 5.6µh
LFO BUFFER Q203
C236 33
C273 430
R237 15K 7W
R221 1.5K 1/4W
R236 68, 1/4W
R225 15K 1/4W
R226 15K 1/4W
LFO, Q204
R238 68Ω 1/4W
C255 1000
C246 430
C253 56
L225 .68
C254 200
L220 200µh
L222 2.2 µh
R224 150 1/4W
SQUELCH GATE CR104
R229 27K 1W
C256 1000
CR201
R230 10K 1/4W
S220
S204
XT220-XT239
C257 1000
CR202
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
R239 68K, 1/4W
R233 1K, 1/4W
R338 100 1/4W
C369 200mf
C338 1000
C341 1000
V301 6BJ6
V304 6CW4
C363 1000
C360 1000
R127 470
C361 1000
V302 6CB6
V303 6CB6
C357 1000
C358 1000
C359 1000
L112 2.2µh
V101 6BH6
C164 1000
C159 1000
V104 6BJ6
C166 1000
C145 1000
C146 1000
C147 1000
C148 1000
V202 8106
C160 1000
C161 1000
C262 1000
C263 1000
V203 8106
C260 1000
C261 1000
V201 7551
C258 1000
C259 1000
L113 2.2µh
R234 150, 3W
C167 1000
V204 75401-2
C152 1000
V103 6EA8
L115 2.2µh
C150 1000
C149 1000
V102 6AK5
R129 270
R128 47 2W
C161 1000
CR105 8.2V ZENER
C162 1000
C331 (SEL)
C327 12
T302
C326 12
C326 .01mf
R314 15K 1/4W
R316 68, 1/4W
R333 15K 1/4W
R331 680, 1/4W
R346 330
1st. IF Q302
C321 .1mf
2nd IF Q303
C334, 12
T303
DETECTOR CR301
CP301
10K
100K
1MEG
100
150K
180K
100
3000
CR 303 NOISE LIM.
R340 10Ω
R337 10K, 1/4W
R335 10K 1/4W
C368 100
470K
C332 .1mf
C329 .1mf
C330 .1mf
R332 2.2K 1/4W
C339 .1mfd
R334 150 1/4W
R313 2.2K 1/4W
R312 470 1/4W
R317 470K
AGC DELAY CR302
R353 1.5 MEG SEL.
C333 .22mf
R315 6.8 MEG
C335 .22mf
C336 4700
R343 560K
C372 470pf
R311 1K
C374 430pf
R318 1MEG
CP302
C241 1000
R324 2.2K
1000
3.9 MEG
1MEG
.01mf
1MEG
1MEG
100
1000
R321 15K
AUDIO AMP V103-B 1/2 6EA8
C339 .01MF
C370 430
C362 5uf
R341 150 Ω
R131 33K
R344 150K
R345 SEL
R132 50K SQUELCH
R133 100K
C373 2mfd
R323 680
R319 68K 1/4W
C342 22mf
EMITTER FOLLOWER Q304
R320 68K 1/4W
R339 2.2K 1/4W
R322 3.9K 1/4W
I102
No.53 RED
R136 150 2W
I101
No 53 RED
C143 1000
14V. JUMPER
C169 1000
R347 5.6K
IDENT FILTER
S313
Q305
C375 .01
C340 5100
L317
C371 22uf
R348 2.2K
R349 68K
R350 22K

R-02252-K

Figure 6-13 MARK 12B SCHEMATIC FOR CN195 B2 thru B5

"Shaded areas shown on the schematic indicate those points where a change, addition, deletion, or type substitution took place."

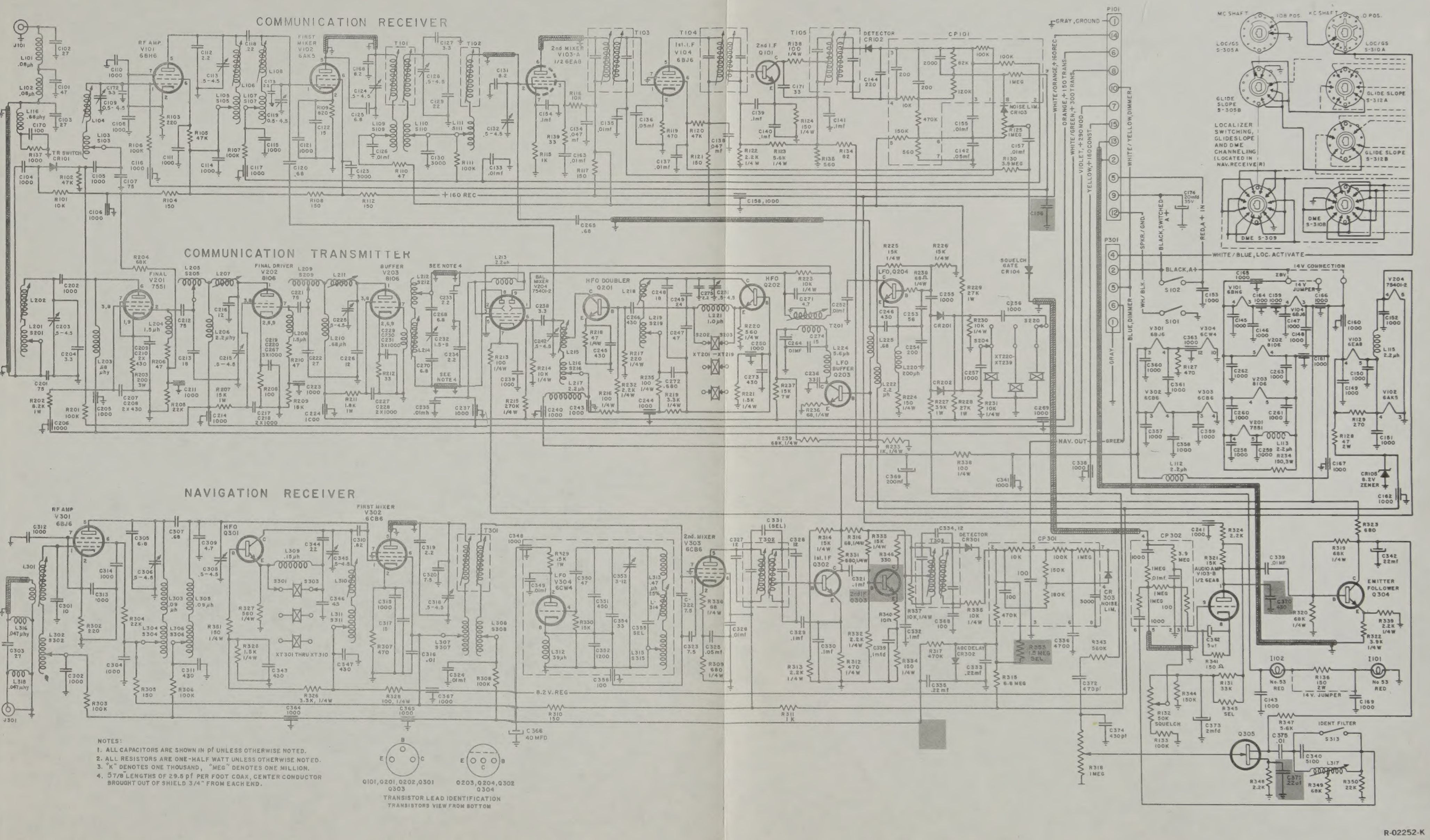
CN195-B2/B5

Minor modifications made to provide better compatibility with other NARCO complementary equipment.

Changed	Q303	75608-0002	TRANSISTOR, SILICON, NPN
Changed	C156	23094-0171	CAPACITOR, MYLAR, 0.047 µf ± 10%, 200V
Deleted	R352		
Added	C370	21291-0025	CAPACITOR, CERAMIC DISC, 430pf ± 10%, 500V
Added	C371	23089-0079	CAPACITOR, CERAMIC DISC, .22µf ± 10%, 75V

Select resistor added to provide Localizer voltage from detector to equal 2.1V ± .1V rms.

Added	R353	31192-SEL	RESISTOR, CARBON, Selected ± 10%, ¼W


COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
RF AMP V101 6BH6
FIRST MIXER V102 6AK5
2nd MIXER V103-A 1/2 6EA8
DETECTOR CR102
FINAL DRIVER V202 8106
BUFFER V203 8106
HFO DOUBLER Q201
HFO Q202
LFO DUFFER Q203
SQUELCH GATE CR104
RF AMP V301 6BJ6
HFO Q301
FIRST MIXER V302 6CB6
2nd MIXER V303 6CB6
LFO V304 6CW4
EMITTER FOLLOWER Q304
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
GLIDE SLOPE
DME
8.2 V. REG
+160 REC
NAV. OUT
R-02252-K

NOTES:
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 5 7/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.

Q101, Q201, Q202, Q301 Q303
Q203, Q204, Q302 Q304
TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

Figure 6-13 MARK 12B SCHEMATIC FOR CN195 B2 thru B5

GREAT LAKES AIRMOTIVE, INC.
Willow Run Airport
(HUnter 2-2621 or LO 5-4303)
Ypsilanti, Michigan

narco Mark 12A VHF Transceiver

with

NAVIGATION RECEIVER

and

T12MP-12A or T24MP-12A MODULATOR-POWER UNIT

PRELIMINARY MAINTENANCE DATA

for

CN144-A

INTRODUCTION.

An Installation Manual, 3077-620, is packed with each Equipment shipped. It contains all the information required to make a complete installation.

The information supplied herewith consists of the following major items:

CIRCUIT DESCRIPTION.
MAINTENANCE, SERVICE PROCEDURES.
TABLES.
BLOCK DIAGRAM.
TEST CIRCUITS.
PHOTOS with SYMBOLS.
SCHEMATICS.

A Complete MAINTENANCE MANUAL, 3077-600, is now being prepared.

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

Printed in U.S.A.

November, 1965

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SECTION 1
INTRODUCTION

1-A. INTRODUCTION.

The ***narco*** Mark 12A is a combination VHF communication transceiver and a wholly independent VHF navigation receiver using advanced circuit techniques for high reliability. The panel unit contains the communication transceiver and navigation receiver sections, while the remotely-located modulator-power unit contains the audio and power sections.

The Mark 12A incorporates a NAV ident filter, continuous NAV receiver operation while transmitting. The Mark 12A panel unit and modulator/power unit, however, are interchangeable with their Mark 12 counterparts.

1-A,1. Panel Unit.

The VHF Transceiver is designed to be used as a primary communications apparatus. It is controlled by the left hand frequency selector of the Panel Unit. It is available with either 90 or 360 crystal controlled channels. A kit of crystals, obtainable from ***narco***, can be installed at any time to convert a 90-channel Mark 12A for operation on 360 channels. Both receiver and transmitter are controlled by the same channel selector.

A 100 channel VHF Navigation Receiver is controlled by the right hand frequency selector. Used with an omni converter it can provide complete VOR/LOCALIZER navigation. An IDENT filter eliminates the code identification from a NAV signal so voice communications can be clearly understood. Pulling the NAV volume control knob disables the filter to permit positive identification of the station. The navigation receiver is not cut off while transmitting. Omni or localizer signals are therefore available at all times. This feature is especially desirable if an autopilot is coupled to the omni converter.

The navigation receiver contains glide slope and DME channel selector switches. Cable and connector kits may be installed at any time to connect these switches to a glide slope receiver, a DME interrogator, or both.

1-A,2. Modulator-Power Unit.

A remote-mounted Unit, the T12MP-12A or T24MP-12A, contains the power supply and audio-modulator. An auxiliary audio input circuit is provided so that one or more other radio equipments may be connected to operate through the ***narco*** Mark 12A Audio Amplifier. This audio input circuit is designed for a level of 50 milliwatts from a 300 ohm source.

A gain control in the microphone input may be adjusted for full modulation with inputs of .06 to 1.5 volts from a 100-ohm source. This control is preset at the factory for carbon-microphone levels.

The T12MP-12A and T24MP-12A Units have been designed to be mounted either horizontally or vertically, by means of the mounting base supplied.

1-B. SPECIFICATIONS.

1-B,1. Communication Transceiver.

a. Frequency Range, Domestic Equipment.
   90 Channel Equipment:
      118.0 thru 126.9 Megacycles/Sec.
         (100 Kc Channel Spacing)
   360 Channel Equipment:
      118.00 thru 135.95 Megacycles/Sec.
         (50 Kc Channel Spacing)

b. Frequency Range, Export Equipment.
   100 Channel Equipment:
      117.0 thru 126.9 Megacycles/Sec.
         (100 Kc Channel Spacing)
   380 Channel Equipment:
      117.00 thru 135.95 Megacycles/Sec.
         (50 Kc Channel Spacing)

1-B,2. Communication Transmitter.

Power Output:
Nominal 10 watts.
Sidetone:
50 Milliwatts.

Modulation:
70% minimum at start of limiting.

Frequency Stability:
Maximum ±0.005% over temperature range of –30°C to +55°C, and line voltage range of 10v to 16v (14v unit) or 20v to 32v (28v unit).

Line Voltage: Will operate, capable of intelligible modulation, over line voltage range of 10 to 16v (14v unit) or 20v to 32v (28v unit)

Microphone:
Carbon, noise-cancelling carbon (low impedance), or dynamic with transistor pre-amp. to be used.

Duty:
Maximum 50%. (1 minute on, 1 minute off)

1-B,3. Communication Receiver.

Sensitivity:
1.5 microvolts maximum for 6 db signal + noise to noise ratio.

Overall Selectivity:
6 db (nose), 30 kc/s minimum bandwidth.
60 db (skirt), 90 kc/s maximum bandwidth.

Image Rejection:
At least 60 db.

AVC.
4 db from 10 to 10,000 microvolts.

Audio Output:
6 watts into 4 ohms.

1-B,4. Navigation Receiver.

Frequency Range:
108.0 thru 117.9 Megacycles/Sec.
(100 kc/s Channel Spacing).

Sensitivity:
1.0 microvolt for 6 db signal + noise to noise ratio.

Overall Selectivity:
6 db (nose), 40 kc/s minimum bandwidth.
60 db (skirt), 100 kc/s maximum bandwidth.

Image Rejection:
At least 70 db.

AVC:
4 db from 10 to 10,000 microvolts.

Tone Filter:
Provides 20 db IDENT rejection.

Audio Output:
6 watts into 4 ohms.

1-B,5. General.

a. Size:
Panel Unit: See Figure 18, page 43.
Modulator-Power Unit: See Figure 19, page 44.

b. Weight:
Panel Unit: 5.7 pounds.
Modulator-Power Unit: 3.9 pounds.

c. Power Required:
At 13.75 Volts, 4.6 amps Receive,
7.9 amps Transmit.

At 27.50 Volts, 2.1 amps Receive,
4.9 amps Transmit.

1-C. LICENSE REQUIREMENTS.

The Federal Communications Commission requires that the operator of the transmitter in this equipment hold a Restricted Radio-Telephone Operator Permit, or higher class license. This permit may be obtained by any U.S. citizen from the nearest field office of the F.C.C.; no examination is required.

The transmitter itself, as installed in the aircraft, requires a Private Aircraft Radio Station License. This license is obtained by filing F. C. C. Form 404.

Since this equipment has been type-accepted by the FCC and entered on their list of type-accepted equipment as "***narco*** Mark 12A" it must be identified as "***narco*** Mark 12A" on your FCC Form 404 Station License Application.

CAUTION: The VHF transmitter in this equipment is guaranteed to meet Federal Communications Commission approval only when ***narco*** crystals are used.

When ordering crystals for additional channels or replacements, state ***narco*** model number to insure getting properly correlated crystals.

Use of other than ***narco*** crystals will void manufacturers warranty.

SECTION 2
INSTALLATION

2-A. INTRODUCTION.

See introduction to Section 1, page 7.

2-B. SPECIFICATIONS.

See specifications under Section 1, page 7.

2-C. UNITS and ACCESSORIES SUPPLIED.

1. ***narco*** Mark 12A Panel Unit.
   a. Domestic: 90 or 360 Communication Channels, as ordered.
   b. Export: 100 or 380 Communication Channels, as ordered.
2. Power Audio Unit.
   T12MP-12A for 14 volt operation, or
   T24MP-12A for 28 volt operation, as ordered.
3. Antenna connector, COM Transceiver.
   narco Part No. 41130-1.
4. Antenna connector, NAV. Receiver.
   narco Part No. 41237-1, Plug; with 41237-2 Ferrule.
5. Mounting base-plate, for T12MP-12A or T24MP-12A.
   narco Part No. 52085-101.
6. Set of four front panel labels ***narco*** Part No. 04271.
7. PLUG, OMNI Connector, ***narco*** Part No. 41116-1.

2-D. ACCESSORIES REQUIRED, but Not Supplied.

1. CABLE: Modulator-Power and Accessory.
   a. 8 feet long, ***narco*** Part No. 90618-96, or 90635-96.
   b. 16 feet long, ***narco*** Part No. 90618-192, or 90635-192.
2. COMMUNICATION ANTENNA: See Section 2-J,1.
3. NAVIGATION ANTENNA: ***narco*** VRP-15A, ***narco*** VRP-37, or equivalent. See Section 2-J,2.
4. COMMUNICATION ANTENNA CABLE, see Section 2-J,1
5. NAVIGATION Antenna Cable, see Section 2-J-2.
6. Headphones: Low Impedance type, 300 to 1000 ohms, or Loud Speaker, Voice coil impedance, 3 to 6 ohms nominal. Both headphones and speaker may be used if desired.
7. Microphone: Carbon, noise-cancelling carbon (low impedance), or dynamic with transistor pre-amp. The quality of transmission depends to a considerable extent on the quality of the microphone used. A noise cancelling type is very helpful and is recommended.

2-E. OPTIONAL UNITS and ACCESSORIES AVAILABLE.

2-E,1. Cables and Connectors.

a. Glide Slope Switching Cable and Connector Kit: (required if a glide slope receiver is to be controlled by the switches provided in the Mark 12A), ***narco*** Part No. EL-3077-500.

b. DME Switching Cable and Connector Kit: (required if a DME interrogator is to be controlled by the switches provided in the Mark 12A), ***narco*** Part No. EL-3077-501.

c. Connector Kit, for Modulator-Power and Accessory Cable (Required for field fabrication of the main interconnecting cable) ***narco*** Part No. EL-3077-502.

2-E,2. Omni Converters.

a. ***narco*** VOA-4. Omni Converter. For VOR or LOCALIZER Course Deviation.

b. ***narco*** VOA-5. Omni Converter, with Glide Slope Indicator. For VOR, LOCALIZER or Glide Slope Deviation.

c. ***narco*** VOA-6. Omni Converter. For VOR Course Deviation.

d. ***narco*** VOA-8 OMNI Converter. For VOR or LOCALIZER Course Deviation.

e. ***narco*** VOA-9 OMNI Converter with Glide Slope Indicator. For VOR, LOCALIZER or Glide Slope Deviation.

2-E,3. Quartz Crystals.

a. Crystal Kit, for conversion of Mark 12A Transceiver from 90 to 360 Communication Channels. ***narco*** Part No. EL-3077-503.

2-F. MECHANICAL INSTALLATION.

2-F,1. Panel Unit.

In mounting the ***narco*** Mark 12A Panel Unit the case is installed first, using mounting brackets on the sides and a grounding and supporting strap attached to the rear of the case. These supports must be fabricated by the installer. See Figure 18, page 43 for mounting dimensions.

a. Rear-Mounted Case (recommended).
Install the grounding and supporting strap from the rear stud of the case to a structural member of the airframe. Allow sufficient space behind the case for cables and access to the "airloc" fastener. Remove all paint and other finishes from the airframe, to make a good electrical ground where the supporting strap is attached.

b. Front Panel Mounting.

Where there is an existing cutout or where space limitations will not permit rear case-mounting, the case may be mounted from the front of the Instrument Panel. The cutout required to provide clearance for the mounting bracket bosses on the case will not be completely covered by the Mark 12A Trim Panel when the unit is inserted in the case.

Install a grounding and supporting strap from the rear stud of the case to a structural member of the airframe. Allow sufficient space behind the case for cables and access to the connectors.

2-F,2. Front Panel Labels.

For installation convenience and professional operational identification, a complete set of self-adhering NAV and COM labels for the Mark 12A is provided with each equipment. These labels may be used in multiple equipment installations to identify NAV-1, NAV-2, etc.

The labels should be affixed to the Front Trim Panel in the following locations:

a. For the COM Section at the upper left corner, above the panel mounting screw.

b. For the NAV Section at the upper right corner, above the panel mounting screw.

2-F,3. Modulator-Power Unit.

A Mounting Base is provided to be permanently installed in the aircraft. The Modulator-Power unit is attached to this base in a manner which permits easy removal for inspection or servicing. See Figure 19, page 44 for details .

The Mounting Base and in turn the Modulator-Power Unit must have a good electrical ground, similar to the Panel Unit. See 2-F,-1 above.

2-G. ELECTRICAL CONNECTIONS.

The *narco* Mark 12A Equipment consists primarily of a Panel Unit which becomes the central point for the electrical connections to the Modulator-Power Unit and to all other accessories. All connections are associated with the rear of the Panel Unit chassis. The rear of the chassis is readily accessible because the rear of the outside case is open, except for a narrow vertical strap which holds the ground-support stud and "Airloc" fastener.

All connections except the two separate antennas (Communication and Navigation) are made via two connectors attached to a short cable having two branches, extending from the rear of the Panel Unit chassis.

2-G,1. Modulator-Power and Accessory Cable.

The Panel Unit Cable branch having the large 16-circuit connector P-101 is to be connected to J-501, on the Modulator-Power (MP) Unit. Figure 21, page 45, gives the circuits between the mating connectors P-102 and P-501, corresponding with the Panel Unit connector P-101 and the MP Unit connector J-501 respectively.

The Cable Assemblies made by *narco* (See above D., 1.) have, in addition to the connections to the MP connector P-501, a five wire six foot cable breakout for the usual microphone, headphone and loudspeaker connections. Also extending from the opening in the P-102 Cable Connector Shell are three wires about 16 inches long for A+ input, panel lamp dimmer and auxiliary audio input.

2-G,2. OMNI/Localizer Cable.

The Panel Unit Cable branch having the small 6 circuit connector P-301 is provided for connection via a mating connector to an Omni Converter Unit such as the *narco* VOA-4, VOA-5, VOA-6, VOA-8, or VOA-9. Connections for such units are given in the Table below and in the information supplied with the various Omni Converter Units.

The OMNI/LOCALIZER cable should be routed as far as possible from the COM antenna and its cable. Excessive RF pickup on the OMNI/LOCALIZER cable may cause an OMNI needle deflection while transmitting. The VOA-4 and VOA-5 Navigation Converters chassis number CN63D-1 and VOA-6 chassis number CN106B-1 and later production models have rf by-pass capacitors. If rf pickup is experienced when using a Mark-12A with earlier OMNI converters, install 430 pf disc ceramic capacitors (*narco* Part No. 21291-1) between the base and emitter of Q-103 and Q-104 in the VOA-4, VOA-5 or VOA-6 converters. These capacitors should be installed on the wiring side of the printed wiring boards, with leads as short as possible. See the converter maintenance manual for the location of these transistors.

If a *narco* VOA-6 Omni Converter is mounted near enough to MK 12A Equipment, it may be possible to connect the P-301 connector on the MK 12A cable directly to the compatible mating connector on the VOA-6 Equipment.

P-301 Terminal No.	Wire Color	Wire Size	Circuit Function
1	Grey	#18	Ground
2	Black	#18	+ DC Supply
3	No Conn.	—	—
4	White/Blue Tr.	#22	Omni/Loc. Relay
5	Blue	#22	Ext. Dim for VOR
6	Green	#22	Omni Signal

2-G,3. Glide Slope Channel Selector Cable.

The Navigation Receiver Channel Selector is provided with switch sections for simultaneous and automatic Glide Slope Receiver Channel Selection.

To use this switching with a Glide Slope Receiver such as the *narco* UGR-1A or UGR-2, it is necessary to make connections directly to certain switch sections in the Mark 12A Navigation Receiver Channel Selector Assembly. The cable is brought out of the panel unit through the round hole in the rear panel, beneath the modulator-power and accessory cable. Information on the location of the switch sections and the required connections is given in the instructions accompanying the Glide Slope Channel Selector Cable and Connector Kit. (See 2-E,1,a, above).

2-G,4. DME Channel Selector Cable.

The navigation receiver contains switches for automatic DME channel selection.

To use this switching with a DME interrogator such as the ***narco*** UDI-2AR, a cable assembly must be connected to the DME switches in the Mark 12A. The cable is brought out of the panel unit through the round hole in the rear panel, beneath the modulator-power and accessory cable. Instructions accompanying the DME Channel Selector Cable and Connector Kit show the locations of the switches and the connections, (see E,1,b, above).

2-H. PRIMARY POWER.

2-H,1. Power Source.

The primary power source may be either a nominal 14 or 28 volts, depending on the connections in the Panel Unit and whether a T12MP-12A or T24MP-12A Modulator Power Unit is used.

2-H,2. Circuit and Equipment Protection.

The primary DC circuit to the equipment should be protected with a fuse or other protective device rated as follows:

15.0 amps for a nominal 14 volt installation.
7.5 amps for a nominal 28 volt installation.

2-H,3. Voltage Conversion.

a. The Modulator Power Units are made for either a nominal 14 or 28 volt operation and are not convertible from one voltage to the other.

b. The panel unit can be used in either a 14- or 28-volt installation. A few simple wiring changes in the filament and pilot-lamp circuits constitute the voltage changeover. Figure 17, page 42, shows connections for 14 or 28 volts.

2-J. ANTENNA REQUIREMENTS.

2-J,1. Communication.

Satisfactory reception and transmission requires an antenna having a nominal impedance of 50 ohms and a low Voltage Standing Wave Radio (VSWR) over the frequency range to be used.

A simple antenna such as the ***narco*** VTP-17 bent whip may be used with a 90-channel Mark 12A. A broad-band antenna, such as the ***narco*** VP-10, is preferable with a 360-channel Mark12A. A broad-band antenna is also recommended when a 90-channel Mark 12A is installed with the intention of converting to 360 channels later.

Only one antenna is necessary for communication, since antenna changeover switching is built into the panel unit. The communication antenna should be mounted on as large and flat a metallic surface as possible. A suitable surface is often found directly in front of the windshield in fabric-covered ships, or at the center of the cabin roof in metal ships. If no such surface exists, a suitable ground plane may be provided by cementing metal foil on the inside surface of the non-metallic structure. The communication antenna should be located at least 12 inches from other objects on the surface of the aircraft.

2-J,2. Navigation.

In any VHF radio installation, the type of antenna and its location are extremely important. Only with the proper antenna in the best location can the full range and accuracy of the VHF Omni Range system be realized. In installations where an Omni converter is to be used with the ***narco*** Mark 12A navigation receiver **a horizontally polarized antenna is absolutely necessary.**

The quarter-wave whip, normally used for communications, is definitely not satisfactory, although it may appear to be when tried. While vertically polarized components of the omni signal are not normally radiated by the ground station, they are frequently produced by reflections. Therefore, a vertical antenna may receive strong signals not coming directly from the ground station, giving very unreliable bearing information.

If the Navigation Receiver in the ***narco*** Mark 12A Equipment is to be used for communication only, it may be connected to any communication type antenna which is not being used for transmission.

Either the ***narco*** VRP-15A mast-type or the ***narco*** VRP-37 fin-mounting Navigation Antenna may be used with the ***narco*** Mark 12A Navigation Receiver and an Omni Converter. A combination NAV and COM antenna such as the ***narco*** VCNA-1 or VCNA-2 is not recommended since greater frequency separation will be required between NAV and COM channels for full NAV receiver sensitivity while transmitting. See J,3 below.

The RF cable should be RG-58A/U of as short a length as is practical. All bends should have at least a 6" radius.

Two navigation receivers may be connected to one antenna if precautions are taken to provide impedance matching between receivers and antenna. The use of a ***narco*** VP-15 Antenna Diplexer will provide optimum receiver performance. An alternate method, which may result in some reduction in receiver sensitivity (depending on the input impedance of the receivers and the frequency to which each is tuned) is to connect the two receivers in parallel, using a cable 22-⅝" long plus any multiples of 35" necessary for the installation, between the Mark 12A and the interconnecting "T". To determine the length of the cable necessary for any other ***narco*** equipment connecting to this "T", consult the appropriate Instruction Manual.

2-J,3. Important Antenna Information.

For best navigation receiver performance while transmitting, the NAV and COM antennas should be well isolated from each other. The navigation antenna should always be located well away from the engine(s) and propellor(s), and at least two feet from other antennas or wires. A wire, such as an ADF sense antenna, running near the navigation and transmitting antenna can couple transmitter energy into the NAV receiver. A good arrangement is to use a VRP-37 fin-mounting navigation antenna on the vertical stabilizer, and to mount the communication antenna as far forward as possible.

Transmitting on frequencies within about one megacycle of a desired OMNI frequency will reduce NAV receiver sensitivity. The reduction in sensitivity becomes less as the transmitter frequency is separated more from the OMNI frequency. With frequency separation greater than about one megacycle, little desensitization will be observed.

Keying or unkeying the transmitter may produce a transient in the NAV receiver and the OMNI converter. This transient would be observed as a brief jump of the OMNI indicator needle. An autopilot coupled to the OMNI converter will not respond to this transient due to the long time constant in the coupler circuits.

2-K. MICROPHONE GAIN ADJUSTMENT.

The microphone gain control, located in the Modulator /Power Unit, is factory adjusted for carbon microphones. If a microphone with substantially higher output is to be used with the Mark 12A, the gain control should be readjusted as follows:

1. Recommended Method (Bench Adjustment)
   Connect the Mark 12A and T (- -) MP-12A to a primary power source. Connect the microphone to the modulator/power and accessory cable. Connect an oscilloscope to the feed-thru capacitor located in the left front corner of the chassis (violet wire attached to this feed-thru).
   Connect a 50 ohm, 10 watt, dummy load to the COM antenna jack. If possible, have the pilot speak into the microphone in his normal manner. Turn the gain control fully counterclockwise. Key the transmitter and, while speaking into the microphone, adjust the gain control until the positive and negative voice peaks, viewed on the oscilloscope, begin flattening.
2. Alternate Method (Adjustment in Aircraft)
   Connect the microphone to the Mark 12A. Connect the common lead of a Simpson Model 260 VOM, or equivalent, to the Mark 12A chassis. Connect the probe to the feed-thru capacitor located in the left front corner of the chassis (violet wire attached to this feedthru). Set the VOM function selector to "output." Key the transmitter and while speaking a sustained "ah" into the microphone, adjust the gain control for a reading of 60 to 75 volts on the VOM.

2-L. POST-INSTALLATION CHECKOUT.

After the installation has been completed, it should be operated on the ground, with all normal power turned on and the engine(s) running. The receivers should be checked for proper operation by channelling to available signals. A ground check of the transmitter should be made to determine output and audio quality. This may be done by contacting the control tower.

CAUTION

When making tests on the COM Receiver with a Signal Generator connected to the COM Antenna Connector, do not close the microphone switch or activate the transmitter in any way. This is to protect the signal generator from transmitter output power.

SECTION 3

OPERATION

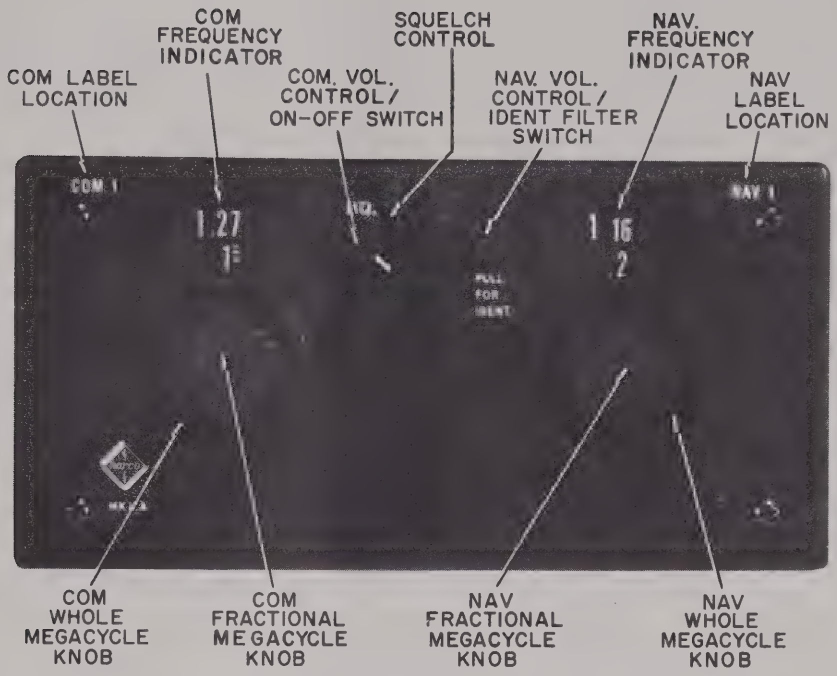

COM LABEL LOCATION
COM FREQUENCY INDICATOR
COM. VOL. CONTROL/ ON-OFF SWITCH
SQUELCH CONTROL
NAV. VOL. CONTROL / IDENT FILTER SWITCH
NAV. FREQUENCY INDICATOR
NAV LABEL LOCATION
COM 1
1 27
NAV 1
1 16
2
PULL FOR IDENT
narco
COM WHOLE MEGACYCLE KNOB
COM FRACTIONAL MEGACYCLE KNOB
NAV FRACTIONAL MEGACYCLE KNOB
NAV WHOLE MEGACYCLE KNOB

Figure 1. Controls.

3-A. INTRODUCTION.

The ON-OFF switch, part of the COM volume control, is in the primary DC line. It is OFF in the full counterclockwise position. The COM volume control affects only the COM receiver. Volume increases with clockwise rotation.

The squelch control is used to cut off COM receiver output when no signal is being received. As the control is rotated counterclockwise, stronger signals are required to override the squelch circuit action.

The NAV volume control affects only the NAV receiver. Volume increases with clockwise rotation.

Pulling the NAV volume control knob defeats the built-in ident tone filter. Code identification may then be heard. With the knob pushed in, the 1020 cps tone is removed.

The COM and NAV receivers are tuned by individual channel selectors. The knobs are turned until the desired frequency appears in the panel cutout above the channel selector.

The COM transmitter and receiver are tuned to the same frequency. Pressing the push-to-talk switch on the microphone activates the transmitter.

3-B. OPERATING PROCEDURES.

Detailed information on operation procedures is provided in the Operating Instructions booklet shipped with each unit.
Additional information on operating practices is provided in the FAA Airman's Information Manual.

SECTION 4

CIRCUIT DESCRIPTION

4-A. INTRODUCTION.

The *narco* Mark 12A Equipment is contained in a Panel Unit intended for aircraft instrument panel mounting and a Modulator-Power Unit which may be mounted in a remote location. The two units are interconnected by a cable which may be as much as 16 feet long.

4-A,1. Panel Unit.

The Panel Unit contains two major items, a Communication Transceiver and a Navigation Receiver. The Transceiver consists of a VHF Transmitter and Receiver, operated by a single control, to provide "simplex" communication on either 90 or 360 crystal controlled channels. The Navigation Receiver has 100 channels for OMNI Navigation and ILS Localizer service. Separate connectors are provided for Communication and Navigation Antennas.

The Panel Unit may be operated on a nominal DC Supply Voltage of either 14 or 28 volts, depending on a few simple connection changes on a terminal strip.

4-A,2. Modulator-Power Unit.

The Modulator-Power Unit contains an Audio Amplifier/Modulator and a DC to DC Converter. The Audio Amplifier serves as the transmitter modulator in the transmit condition and operates the headphones and loudspeaker in the receive condition. The DC to DC Converter changes the primary DC supply to the DC voltages required by the various circuits.

The Modulator-Power Units are not convertible from one primary DC voltage to another. There are two types available. The Type T12MP-12A is to be used on a nominal 14 volt DC supply and the Type T24MP-12A is to be used on a nominal 28 volt DC supply.

4-B. COMMUNICATION TRANSCEIVER.

4-B,1. Oscillators.

The communication transceiver consists of a VHF transmitter and receiver tuned to the same frequency by one set of frequency selector knobs. It provides simplex operation on 90 or 360 crystal-controlled channels in the domestic model, and on 100 or 380 channels in the export model.

The COM high-frequency oscillator (HFO) is a crystal-stabilized Colpitts circuit using fifth-overtone crystals in the 63 through 73 Mc/s range. The HFO transistor Q-202, is a UHF silicon transistor which provides stable operation over a wide temperature range. The collector circuit of Q-202 is tuned by C-247, C-248, C-249, C-251 and L-218 with a step inductor, L-219, which adjusts the tank to resonance at each frequency. Feedback is applied to the oscillator emitter through the crystal, which operates in its series-resonant mode. The choke across the crystal, L-221, is parallel-resonant with the crystal holder capacitance in the oscillator frequency range. It prevents free-running oscillation should a crystal fail.

HFO output is coupled through C-266 to the base of Q-201, the HFO doubler. Q-201 is biased near cutoff, and its collector tank is tracked to tune at twice the oscillator frequency. It therefore doubles the HFO frequency. The doubler output frequencies range from 126 to 145 Mc/s. Table I gives the oscillator and doubler frequencies for each whole megacycle position.

The COM low-frequency oscillator (LFO) is a crystal-controlled Colpitts oscillator operating in the 8.5 to 9.5 Mc/s range. For any communication channel, the LFO frequency for transmitting is always removed .500 Mc/s from the frequency for receiving. Table II gives the transmit and receive crystal frequencies for each fractional megacycle channel.

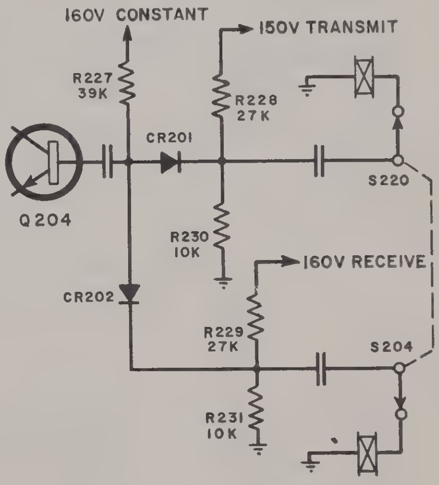


Figure 2.
COM LFO DIODE SWITCHING.

Switches S-204 and S-220 are attached to one rotor, and always select two crystals separated by .500 Mc/s. Diodes CR-201 and CR-202 select the proper crystal for transmitter or receiver operation. The anodes of both diodes are biased at about +30 volts through R-227, which is attached to the +160 v. constant line. During transmission periods, the cathode of CR-201 is raised to about +50 volts by voltage divider R-228 and R-230, from the +150 v. transmit line to ground. CR-201 is therefore reverse biased. CR-202, however, conducts through R-231 and presents a low-impedance path from the transistor base to S-204. In the receive mode the situation is reversed. CR-202 is reverse biased by voltage from the +160 v. receive line, while CR-201 conducts and connects S-220 to the transistor. LFO output is taken from the emitter of Q-204.

4-B,2. Communication Transmitter.

The desired transmitter frequency is generated by V-204, a 6AR8 beam-deflection balanced mixer. C-238 couples energy from the HFO doubler to the control grid of the mixer. Q-203 amplifies LFO energy. T-201, a broad-band tuned transformer, steps the amplified LFO signal up to the voltage needed to drive the mixer deflection plates.

The plate load for the mixer is a balanced circuit tuned to the transmitting frequency. Much of the tuning capacitance is in the two pieces of shielded cable connecting the mixer plates to L-214 and step inductor L-212. This balanced circuit suppresses doubled HFO energy, which is applied to the mixer unbalanced. LFO energy, although applied to the mixer in a balanced fashion is, far enough removed from the transmitting frequency to be adequately attenuated by the transmitter tuned circuits.

The transmitter consists of three amplifiers, V-201, V-202 and V-203. They are coupled to each other and to the antenna by tracked pi-networks. A low-pass filter, consisting of L-101, L-102, C-101, C-102 and C-103, attenuates harmonics of the transmitting frequency. L-116 and C-170 form a series-resonant trap to further attenuate LFO energy.

4-B,3. Communication Receiver.

The communication receiver is a double-conversion superheterodyne receiver using a tracked high-frequency IF and a fixed low-frequency IF. The signal from the antenna is fed to the RF amplifier, V-101, through the transmit-receive switch, CR-101.

In the receive mode, CR-101 is forward biased by voltage from the +160 v. transmit line, applied through R-101. The diode then presents a low impedance to RF signals. When transmitting, the +160 v. receive voltage is removed, and negative voltage from the control grid of the transmitter final amplifier, V-201, is applied to the diode through R-204 and R-101 to reverse bias the diode. In this "off" state, the diode prevents transmitter energy from blocking or damaging the receiver.

The VHF signal is amplified by V-101 and coupled by a tuned circuit to the first mixer, V-102. Doubled HFO energy is also applied to this tube through C-120. The doubled HFO frequency is 8.5 to 9.5 Mc/s higher than the received signal frequency. The two signals mix in V-102 to produce an intermediate frequency in the 8.5 to 9.5 Mc/s range.

The intermediate-frequency signal is coupled to the second mixer by three coupled tuned circuits. The first two branches are inductively coupled by T-101, and the second and third branches are bottom-capacitance coupled by C-130. Since the doubled HFO frequency is constant for all twenty fractional megacycle channels associated with any whole megacycle channel, there are twenty possible intermediate frequencies. The high-frequency IF circuits are tuned to these twenty frequencies by step inductors L-109, L-110 and L-111, which are driven by the fractional megacycle selector knob.

The high-frequency IF signal is applied, along with the COM LFO signal, to the control grid of the second mixer, V-103-A. The LFO frequency is always .500

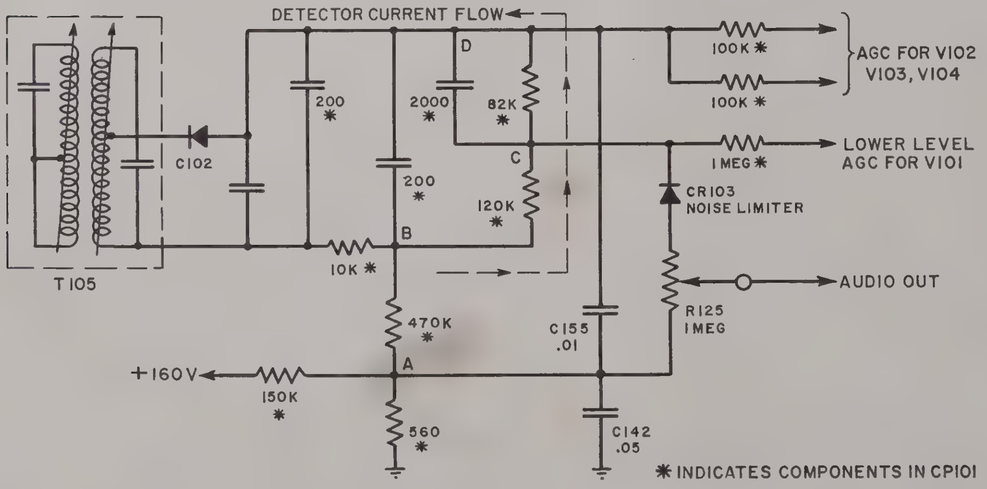


Figure 3. COM Detector Schematic

Mc/s removed from the high-frequency IF frequency. For the .00 through .45 fractional megacycle positions, the LFO frequency is .500 Mc/s lower than the high-frequency intermediate frequency. For the .50 through .95 positions the LFO frequency is .500 Mc/s higher than the high-frequency intermediate frequency.

The two signals mix in V-103-A to produce a .500 MC/s low-frequency intermediate frequency. This signal is amplified by V-104 and Q-101, then detected by CR-102.

The voltage divider formed by the 150K ohms and 560 ohms resistors in CP-101 holds point A at approximately 0.5 volt above ground. As long as no current flows through the 470K resistor, point B is at the same potential as point A. Detector current flow through the 120K and 82K resistors causes points C and D to be more negative than points A and B. These potentials are used as AGC. AGC from point C is at a lower level than that at point D. That from point C is applied to V-101 which, being a sharp cut off pentode, would be cut off by the higher potential at point D.

The voltage developed across the 120K resistor by detector current flow forward biases CR-103, the COMM noise limiter. CR-103 then presents a low impedance to audio signals, which appear across volume control R-125. The 2000 pf capacitor is a relatively high impedance at audio frequencies. The high frequencies of a noise pulse, however, see the 2000 pf capacitor and C-155 as a low impedance. The voltage across these two capacitors cannot change rapidly enough to follow a noise pulse, so the forward bias on CR-103 is reduced for the duration of the pulse. The diode then presents a high impedance to audio signals, reducing the level of noise signals.

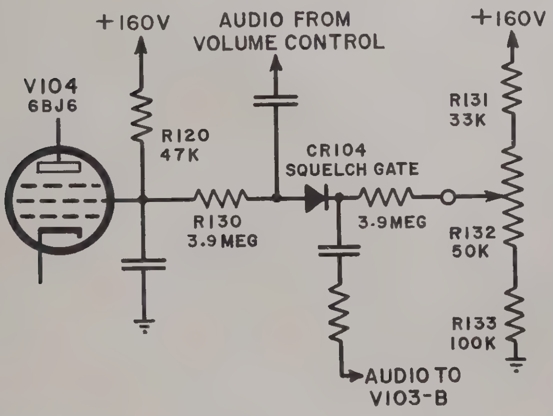


Figure 4. Squelch Gate Schematic

CR-104 is the squelch gate. The anode of this diode is biased by the screen-grid potential of V-104, applied through R-130. The screen potential varies with AGC variations. It is lowest under no-signal conditions, when tube current is high. The cathode potential of CR-104 is set by R-132, the squelch control. If the cathode potential is greater thaen the screen voltage the diode is reverse biased, and the audio signal is blocked. R-132 is set to reverse bias CR-104 under no-signal conditions. When a signal is received, AGC voltage is developed. The screen voltage increases and the diode is forward biased, so it passes the audio signal.

4-C. NAVIGATION RECEIVER.

The Navigation Receiver is a dual-conversion superheterodyne receiver employing a tracked high frequency IF and a fixed low frequency IF. The VHF signal from the antenna is coupled by L-301 and C-301 to the RF amplifier, V-301. It is amplified and coupled by a double tuned circuit to the first mixer, V-302, where it is mixed with the high frequency oscillator output.

The high frequency oscillator is a crystal stabilized, modified Colpitts circuit. Feedback to sustain oscillation is applied through fifth overtone type crystals. The frequency of oscillation is therefore stabilized at the series resonant frequency of the crystal. The A+ voltage for the oscillator transistor, Q-301, is stabilized by a zener diode for frequency stability.

The high frequency oscillator operates in the 96 through 106 Mc/s range. Its frequency is set by the NAV whole megacycle selector. Table III gives the oscillator frequency for each channel.

The plate circuit of V-302 is tuned to the difference between the incoming VHF and the high frequency oscillator frequencies. This high frequency intermediate frequency is different for each setting of the fractional megacycle selector. The high frequency IF transformer, T-301, is tuned for each different frequency by L-307 and L-308. These step inductors are controlled by the fractional megacycle selector.

The high frequency IF signal is mixed with the low frequency oscillator signal in the second mixer, V-303. The low frequency oscillator, V-304, is a Colpitts circuit operating in the 10.3 to 11.3 Mc/s range. It is inductively tuned by step inductor L-315, which is operated by the NAV fractional megacycle selector. The LFO frequency is always 1.125 Mc/s lower than the high frequency IF. Table IV gives the oscillator frequency for each channel.

The difference frequency between the HF IF and the LFO frequency, 1.125 Mc/s, is selected by T-302 and amplified by Q-302 and Q-303. T-302 is overcoupled to provide the necessary bandwidth.

The second IF amplifier (Q-303) output is coupled through T-303 to the detector circuit. The operation of this output transformer is unusual; therefore, a simplified equivalent operational circuit is given in Figure 6 and explained in detail below. Transformer T-303 is tuned as follows: (a) Primary is paralled resonant, and (b) secondary is series resonant with C-334, providing the voltage step-up required for proper OMNI and localizer operation. The primary is adjusted for parallel resonance, which presents a high impedance to the Q-303 collector circuit. The secondary is adjusted for series resonance, which serves to step-up the signal voltage to the detector. The tune-up procedure differs from that for alignment of other IF transformers. Refer to paragraph 5-G,1, Page 29 for alignment instructions.

As shown in Figure 5, detector current flowing through CR-303, the secondary of T-303, and the 150K and 180K resistors forward biases CR-303. C-336 prevents the potential at the cathode of CR-303 from changing very rapidly, although it can follow audio frequencies to slightly over 2000 CPS. The cathode cannot follow a fast noise pulse. Noise pulses, therefore, drive the cathode of CR-303 negative with respect to the cathode. The diode is then biased off and presents a high impedance to audio signals for the duration of the noise pulse.

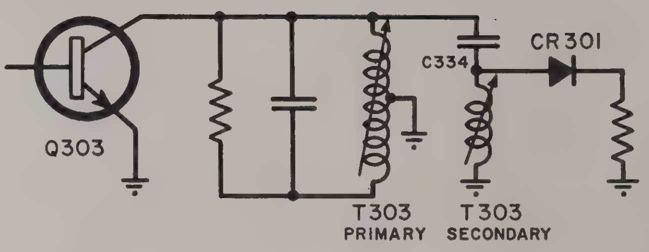


Figure 6.
IF Transformer T-303, Equiv. coupling circuit

CR-302 sets the AGC threshold. Under low-signal conditions, CR-302 is forward biased by potential from the +160V constant line through R-315. The AGC line is therefore slightly above ground potential. As the signal level increases, the negative voltage at the detector load reverse-biases CR-302, and the negative AGC voltage is applied to the tubes.

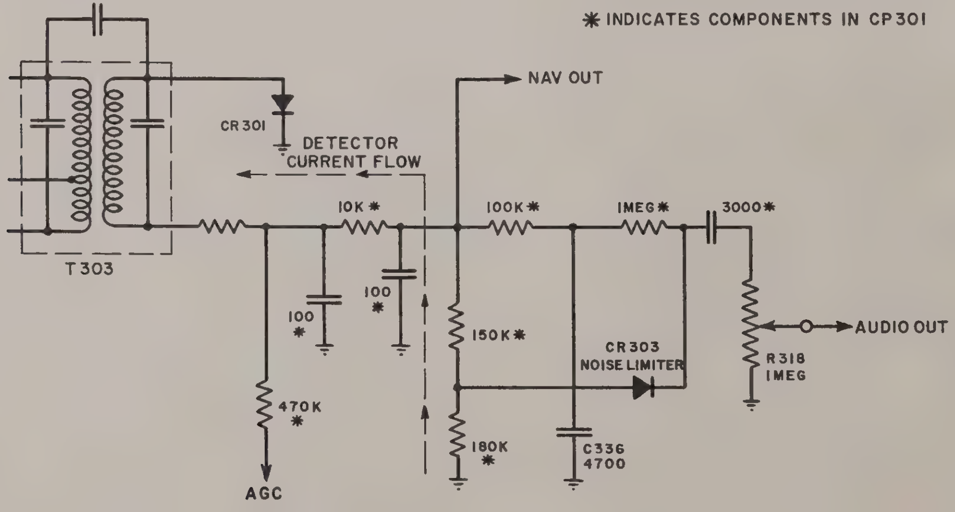


Figure 5. NAV Detector Schematic

4-D. MODULATOR-POWER UNIT.

4-D,1. Power Circuits.

The power supply section of the T( ) MP-12A uses two power transistors, Q-501 and Q-502, and a power transformer, T-501, in a circuit whose simplified operation is as follows. The instant primary voltage is applied (A+), because of the inevitable dissimilarity of the two transistors more current will flow in one than in the other. This greater flow of current through one half of the primary winding of the power transformer induces a bias on the transistors such that the conducting unit is driven into greater conduction and the other is held at cut-off.

Almost instantly the transformer reaches saturation. Thus having reached maximum flux density, there is no more induced voltage in the bias windings which are connected to the transistor circuitry. Therefore, the current through the conducting transistor decreases, and bias voltage at opposite polarity is developed which cuts off this transistor and simultaneously causes the second transistor to conduct. The above procedure repeats with the second transistor. This switching action repeats at high speed and the resultant output voltage of T-501 is essentially a square wave.

A full wave bridge rectifier consisting of CR-501, CR-502, CR-503, and CR-504 in conjunction with the center tapped secondary of T-501 provides a simple means of obtaining a dual voltage output. Filtering of these DC voltages is easily accomplished because of the high frequency of the power supply.

4-D,2. Audio Circuits.

Audio signals from the two volume controls are combined in CP-302, then applied to the grid of the first audio amplifier, V-103-B. The amplified audio signal at the plate of V-103-B is applied to the base of Q-304 through a parallel tuned filter consisting of C-340 and L-317. This filter is tuned to 1020 cps. It presents a high impedance at this frequency to provide approximately 20 db rejection of the code identification tone transmitted by navigation stations. S-313, the push-pull switch attached to the NAV volume control, shorts out the filter when pulled. This permits the pilot to hear the code identification. When the knob is pushed in the tone is reduced to make voice transmissions more understandable. Q-304 is an emitter follower providing an impedance match to the audio power amplifier.

The remainder of the audio circuit is located in the modulator/power unit. In the receive mode, the audio signal from Q-304 is switched by K-501 to the base of Q-401, the audio driver. The audio output is switched by K-501 to the speaker output lead, and is applied at all times to the headphone lead.

In the transmit mode, audio signal from the microphone is switched by K-501 to the base of Q-401. Audio output is taken from the modulation winding of T-402. In this case, K-501 switches B+ to the modulation winding to activate the transmitter.

SECTION 5
MAINTENANCE
SERVICE PROCEDURE

5-A. INTRODUCTION.

The ***narco*** Mark 12A Equipment consists primarily of an aircraft instrument Panel Unit, having direct manual controls and a remote mounted modulator-power unit. All interconnections are normally made at or near the rear of the Panel Unit. There are separate single circuit connectors for the Communication and Navigation Antennas on the rear panel.

From the maintenance standpoint, the Mark-12A is similar to the Mark-12. The following differences should be noted however:

- All oscillators except the NAV LFO are transistorized and are powered by a zener diode-regulated source.
- The output IF amplifier in each receiver is transistorized.
- To couple adequate power from the NAV receiver to a navigation converter, a special IF alignment procedure is employed.
- The navigation receiver operates at all times, including transmitting periods.
- An ident filter is added in the audio circuit.
- The frequency-selector knobs are redesigned.
- Layouts of both the panel unit and the power supply have been revised for easier servicing.
- A microphone gain control is added to the power supply.

5-A,1. Panel Unit Connections.

The Panel Unit has a short cable with two branches extending from the rear. The smaller branch has a 6 circuit connector which may connect directly or via an extension cable to a ***narco*** VOA-6 OMNI Converter, or via an adaptor cable to a ***narco*** VOA-4, VOA-5, VOA-8, VOA-9 or other Navigation Converter. The larger branch has a 16 circuit connector to accommodate the connector and cable for the Modulator-Power Unit and the connections to the primary DC power and accessories.

If a glide slope receiver or DME interrogator is controlled by the NAV receiver channel selectors, there will be one or two additional cables extending from the rear of the panel unit.

For details of these interconnections see Figures 23 and 24.

5-A,2. Replacement Parts.

A complete list of replacement parts is on pages 57 through 67. The following table lists the parts most often needing replacement. In some cases, realignment may be necessary after replacing a part. V-204 is specially constructed for electrical balance. It should, if possible, be replaced with one obtained from ***narco***. Most of the transistors and diodes are manufactured to ***narco*** specifications. The commercial replacements listed are not exact equivalents, and should be used only if absolutely necessary.

Item	Total Quantity	*narco* Part No.	Commercial Replacement
DIODES			
CR-101			
CR-102, CR-301	1	75013-5	1N486B
CR-103, CR-104,	2	75019-2	CD6487
CR-201, CR-202,			
CR-302, CR-303	6	75013-4	1N486B
CR-105			
CR-501, CR-502,	1	75025-2	8.2V, 1 Watt Zener
CR-503, CR-504,			500 PIV, 750 ma
	4	75204-45	Silicon Diode
CR-505, CR-506	2 (28V		500 PIV, 750 ma
	Unit only)	75204-45	Silicon Diode
FUSES			
F-501	1 (14V		
F-501	Unit only)	66504-12	10A, SLO-BLO
	1 (28V		
	Unit only	66504-10	6-¼ A, SLO BLO
LAMPS			
I-101, I-102	2	#53 RED	#53 RED
TRANSISTORS			
Q-101, Q-201,			
Q-202, Q-301,	5	75547-2	2N3478
			(see above)
TRANSISTORS (Continued)			
Q-303			
Q-203, Q-204,			
Q-302, Q-304	4	75550-7	2N3391
Q-401	1	75534-4	2N376A
			(hfe = 120 to 160)
Q-402, Q-403	2 (14V		
	Unit only)	75534-3	2N376A
			(hfe = 100 to 130)
Q-402, Q-403	2 (28V		
	Unit only)	75511-3	2N1136B
Q-501, Q-502	2 (14V		
	Unit only	75548-3	2N441
Q-501, Q-502	2 (28V		
	Unit only)	75505-3	2N174
TUBES			
V-101	1	6BH6	6BH6
V-102	1	6AK5	6AK5
V-103	1	6EA8	6EA8
V-104,			
V-301	2	6BJ6	6BJ6
V-201	1	7551	7551
V-202,			
V-203	2	8106	8106
V-204	1	75401-1	6AR8
			(see above)
V-302,			
V-303	2	6CB6	6CB6
V-304	1	6CW4	6CW4

5-B. MECHANICAL MAINTENANCE.

5-B,1. Panel Unit Access.

The Panel Unit Case is normally installed permanently in the aircraft. To remove the unit, it is only necessary to disconnect the cables at the rear of the chassis and release a single "Airloc" fastener. The unit may then be withdrawn from the front of the case.

The open frame chassis design is such that practically every component, except the ones in the three small shielding compartments, is readily accessible as soon as the unit is withdrawn from the case. Disassembly and re-assembly of the COM and NAV Channel Selectors is somewhat involved, but detailed instructions for the procedure are given in paragraphs B,4 through B,11 below.

The components in the three small shielding compartments are made accessible by removing the covers, which are held in place by small screws. The two compartments near the center of the chassis have both top and bottom covers.

A certain sequence of replacing the covers of the center compartments is helpful. The bottom cover on the left center (COM side) may be removed and replaced without disturbing the top cover. However, if the top cover is removed, it will be easier to remove the bottom cover before reassembly of the top cover. Once the top cover is in place, the bottom cover may be re-assembled without difficulty.

NOTE: The bottom cover fits *inside* the top cover.

The top cover on the right center compartment (NAV Side) may be removed and replaced without disturbing the bottom cover. However, if the bottom cover is removed, it will be easier to first remove the top cover before reassembly of the bottom cover.

The remaining compartment at the bottom left front (COM side) has only one cover. It is held in place by one screw at the rear flange of the cover and two tabs on the front flange of the cover. The tabs fit into slots at the front of the compartment proper.

5-B,2. Modulator-Power Unit Access.

The Modulator Power Unit is usually installed in a remote location on a Mounting Base. The Mounting Base is normally installed permanently. To remove the Unit, it is only necessary to loosen (without removing) four mounting crews and detach the single cable connector. Access to all components is then made by removing the screws holding the two "L" shaped pieces covering the four sides.

If the Transistor Q-401 (First Audio Amp.) is removed, care must be exercised to prevent damaging the insulator under the mounting, and to replace it properly.

5-B,3. Periodic Service.

The only item which may require occasional attention is the COM Fractional Mc Channel Selector Detent Assembly, near the rear of the chassis. It consists of a star wheel, roller, and detent fulcrum, which should be lubricated with wide temperature range grease. It is recommended that this assembly be checked whenever the Unit is removed for electrical maintenance.

5-B,4. Channel Selector Knob, Dial and Shaft Removal, Replacement and Positioning.

The procedures for disassembly and re-assembly of the Channel selectors given in the succeeding paragraphs B,5., through B,9., give a procedure which should maintain the proper relations among the Knobs, Dials, Shafts, and Switch Section Rotors and Stators. If these relations become mis-arranged for any reason the correct relations may be re-established according to the sub-section B,10., below.

NOTE: In the succeeding sub-sections through B,11., all references to mechanical position such as top and bottom, left and right, front and rear as viewed facing the front of the Panel Unit in an upright position.

5-B,5. COM Fractional Mc Shaft, Removal and Replacement.

Removal Procedure:

a. Remove detent spring and roller which engages the star wheel assembly at the left side rear of the set on the COM, Fractional Mc Shaft and then loosen the two set screws in the star wheel assembly.

b. Rotate the COM Mc Knob to the 118 position, the COM Fractional Mc Dial to the 0.3 position, and the NAV Mc Knob to the 108 position and the NAV Fractional Mc Dial to the 0.6 position.

CAUTION: If the knobs and dials are not set as indicated, the switch sections may be damaged, when the shafts are removed as described under step g. below.

c. Loosen set screws and remove from the unit both volume knobs, squelch knob, and both whole megacycle knobs.

d. Loosen and remove the four screws at the corners of the trim panel. The panel can now be removed by pulling it forward from the unit.

e. Loosen set screws in both fractional megacycle knobs and in both whole megacycle dials. Set screws in the dials are accessible when the fractional megacycle knobs are rotated to line up access holes.

f. Front of chassis is now exposed. On the left hand side is the COM Mc detent. Remove its screws, nuts, lockwashers, and the spacers which retain the detent assembly to the front of the chassis.

g. Note that it is necessary to remove the COM Mc Shaft in order to remove the COM Fractional Mc Shaft. Both COM Mc Shaft and detent assembly and COM Fractional Mc Shaft can now be withdrawn simultaneously from the front of the chassis.

Replacement Procedure: Follow the Removal Procedure in reverse.

5-B,6. COM Whole Mc Shaft and Detent Assembly, Removal and Replacement.

Removal Procedure:

Follow instructions described in Removal Procedure B,5., above but omit step a. and step g. The COM Mc Shaft and Detent Assembly can now be withdrawn from the front of the chassis without disturbing the COM Fractional Mc Shaft and Detent.

Replacement Procedure:

Follow the Removal Procedure in reverse.

5-B,7. NAV Whole Mc Shaft and Detent Assembly, Removal and Replacement.

Removal Procedure:

a. See Removal Procedure B,5., above and perform steps b., c., d., and e.

b. After the above steps have been completed, the front of the chassis will be exposed and on the right hand side will be the NAV Mc Shaft and Detent Assembly. This can then be removed by loosening and removing the two mounting nuts and lockwashers at the rear of the variable inductor and crystal switch section assembly.

c. In the same area remove the hairpin retainer from the NAV Mc Shaft.

d. On the front of the chassis the two long strut screws can now be removed, but be careful to note the location of the two metal spacers in the wafer assembly.

e. The NAV Mc Detent and Shaft Assembly can now be withdrawn from the front of the chassis.

Replacement Procedure:

Follow the Removal Procedure in reverse.

5-B,8. NAV Fractional Mc Shaft, Removal and Replacement.

Removal Procedure:

a. Position the NAV Fractional Mc Dial to 0.6. Then loosen the set screw which is seated the deepest in the NAV Fractional Mc Knob and remove the knob and its bushing from the Unit.

b. Loosen the two set screws in the hub of the NAV Fractional Mc Dial.

c. At the rear of the L.F. Oscillator, glide slope, and variable inductor switch sections, there is a detent rotor assembly. Loosen the two set screws in the detent rotor assembly and also remove the hairpin retainer on the NAV Mc Shaft in front of the L.F. Oscillator Assembly.

d. Then from the front of the chassis, push in the NAV Fractional Mc Shaft flush with the front of the NAV Whole Mc Shaft. It will be seen by this operation that the NAV Fractional Mc Shaft will be protruding to the rear of the set, at the rear of the LF oscillator and switch section assembly. Continue to withdraw the shaft to the rear of the set.

e. In the rear panel there is a clearance hole provided to facilitate the removal of this shaft. Any wires interfering with this clearance hole should temporarily be carefully dressed aside.

Replacement Procedure:

Follow the Removal Procedure in reverse.

5-B,9. Reference Positions for Channel Selector Dials, Shafts, and Switch Sections.

a. COM Fractional Megacycles.
For the 0.5 Fractional Mc position the ⅜" diameter metal shaft flats will be in a horizontal plane, with the key notch in the Switch Section Rotors at the top.

All of the Switch Section Stators have the letter "X" stamped on the front right side adjacent to the strut screw.

b. COM Whole Megacycles.

For the 118 Whole Mc Position the ⅜" diameter glass epoxy shaft flats will be 18° clockwise from a vertical plane, with all the key notches in the Switch Section Rotors on the right side at 108° clockwise from the vertical.

The first seven Switch Section Stators have the upper right hand corner cut off. The remaining four, have the letter "X" stamped on the top front of the section.

c. NAV Whole Megacycles.

For the 108 Whole Mc position the flats on the ¼" diameter *brass* shaft will be in the same plane as the mounting strut screws in the Crystal Switch Assembly. The key notch in the eight Switch Section Rotors is on the flat toward the bottom of the Unit.

The eight Switch Section Stators have a raised key moulded on the peripheral surface, which appears at the right of the top strut screw.

d. NAV Fractional Megacycles.

For the 0.6 Fractional Mc dial position the flats on the ¼" diameter *steel* shaft shall be in the same plane as the mounting strut screws in the L.F. Oscillator Assembly. The key notch of the rotor in the enclosed shielded switch section (top cover removed) is on the flat toward the top of the Unit. The key notches in the four switch section rotors behind the enclosed shielded switch section, are on the flat toward the bottom of the Unit.

The switch section stator in the shielding compartment has a large cutout at the top. The remaining five stators have a raised key moulded on the peripheral surface, which appears at the right side below the upper strut screw.

5-B,10. COM Detent Spring Position, Fractional Mc, Ch. Sel. Switch.

When the detent star wheel assembly is installed for 10 position operation, the long end of the detent spring shall be located on the inside edge of the tab nearest the shaft.

When the detent star wheel assembly is installed for 20 position operation, the long end of the detent spring shall be located on the inside edge of the outermost tab from the shaft.

5-B,11. NAV Detent Position, Fractional Mc, Ch. Sel. Switch.

This detent position is not related to any particular fractional Mc position, but it must be seated when the rotor blade is centered on any stator contact. This centering may be observed on the switch section in the enclosed shielded compartment, when the top cover is removed.

5-C. ELECTRICAL MAINTENANCE.

5-C,1. Precautions.

a. Supply Voltage.

All specifications in the following sections should be met with a DC input voltage of 13.75 or 27.5 volts, depending on the requirements of the unit being aligned. Unless a well-regulated primary power supply is used, the input voltage must be adjusted to the correct value when the transmitter is keyed.

b. Duty Cycle.
Observe a 50% duty cycle when aligning the transmitter (one minute on and one minute off).

5-C,2. Equipment Required.

a. RF Power Wattmeter — Bird Termaline or equivalent.

b. VTVM — RCA Voltohmyst or equivalent, with RF probe.

c. AC VTVM — Ballentine Model 300D or equivalent.

d. Carbon Microphone.

e. Signal Generator — General Radio Model 1001A or equivalent.

f. Signal Generator — Hewlett-Packard Model 608D or equivalent.

g. Audio Wattmeter — General Radio Type 583-A or equivalent.

h. High Impedance Detector—See Figure 13, Page 41.

i. Frequency Counter — Hewlett-Packard Model 524B or equivalent, or — BC-221-D or equivalent.

5-C,3. Alignment, 90 vs 360 Channels.

The following alignment instructions are written for the 360 channel COM transceiver. For a 90 channel unit, when instructions call for 135 Mc/s use 126 Mc/s, and when .95 is specified use .9.

5-D. COM OSCILLATORS.

5-D,1. COM High Frequency Oscillator.

a. Connect a RF VTVM probe to the base of Q-201, the HFO doubler. Refer to Photo J, page 55.

b. Set the COM megacycle selector to 118. Adjust C-251 for maximum RF indication.

c. Set the megacycle selector to 135. Adjust L-218 for maximum RF indication.

d. Repeat steps b., and c., until no further increase in RF indication can be obtained.

e. Check to insure oscillator is operating in each megacycle position. Operation is indicated by a normal RF voltage reading.

Normal indication: 0.5 to 0.7 V RMS.

5-D,2. COM Low Frequency Oscillator.

a. Connect a RF VTVM probe to the emitter of Q-204, the low frequency oscillator.

b. Check to insure oscillator is operating in each fractional megacycle position. Operation is indicated by a normal RF voltage indication.

Normal indication: 2.0 to 2.5 Volts RMS.

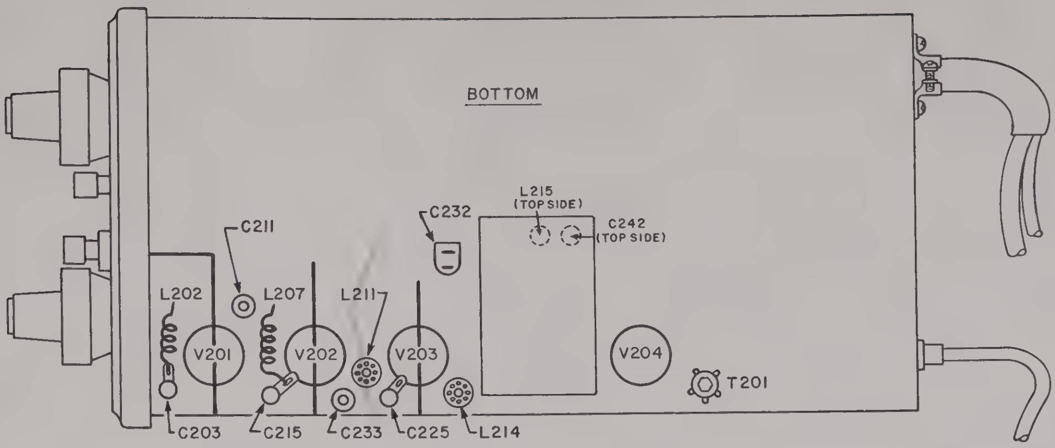


Figure 7.
COM Transmitter, Test Connections.

5-E. COM TRANSMITTER.

5-E,1. Balanced Mixer and Buffer Alignment.

a. Connect a RF wattmeter to J-101, the COM antenna connector.

b. Connect DC VTVM probe to C-223.

c. Set the channel selector dials to 118.50 Mc/s. Key the transmitter and adjust T-201 for maximum negative voltage indication.

d. Key the transmitter and adjust C-242, C-232 and C-225 for maximum negative voltage indication.

e. Set the channel selectors to 135.50 Mc/s. Key the transmitter and adjust L-215, L-214 and L-211 for maximum negative voltage indication.

f. Repeat steps d., and e., until no further increase in negative voltage can be obtained.

g. Set the COM Mc. selector to 135 and readjust T-201 for approximately equal negative voltage indications at the .00 and .95 fractional megacycle positions.

Normal Indication: -2 to -10 Volts DC.

5-E,2. Final Drive Adjustment.

a. Connect the DC VTVM probe to C-211.

b. Set the channel selectors to 118.50 Mc/s. Key the transmitter and adjust C-215 for maximum negative voltage indication.

c. Set the channel selector dials to 135.50 Mc/s. Key the transmitter and adjust L-207 for maximum negative voltage.

d. Repeat steps b., and c., until no further increase in negative voltage can be obtained.

e. Slide the panel unit into its dust jacket. Set the Mc. channel selector to 118. Key the transmitter and adjust C-215 for approximately equal negative voltage indications at the .00 and .95 fractional megacycle positions.

f. Set the Mc. channel selector to 135. Key the transmitter and adjust L-207 for approximately equal negative voltage indications at the .00 and .95 Mc. positions.

g. Repeat steps e., and f., until negative voltage indications at the .00 and .95 Mc. positions are approximately equal at 118 Mc/s or 135 Mc/s. Note that the voltage indication at 118 will generally be different from that at 135. Do not attempt to balance readings at 118 and 135 Mc/s.

Normal Indication: –30 to –60 Volts DC.

5-E,3. Final Amplifier Alignment.

a. Set the channel selectors to 118.50 Mc/s. Key the transmitter and adjust C-203 for maximum RF output power as indicated on the RF wattmeter.

b. Set the channel selectors to 135.50 Mc/s. Key the transmitter and adjust L-202 for maximum RF power output.

c. Repeat steps a., and b., until no further increase in power output can be obtained.

d. Slide the panel unit into its dust jacket. Set the megacycle channel selector to 118. Key the transmitter and adjust C-203 for approximately equal power indications at the .00 and .95 positions.

e. Set the megacycle channel selector to 135. Key the transmitter and adjust L-202 for approximately equal power indications at the .00 and .95 positions.

f. Repeat steps d., and e., until power indications at the .00 and .95 positions are approximately equal at the 118 or 135 position. Note that the power indication at the 118 position will generally be different from that at 135. Do not attempt to balance readings at the 118 and 135 positions.

Normal Indication: Lower frequency 50% of total channels — 9.0 watts minimum.

Higher frequency 50% of total channels — 7.0 watts minimum.

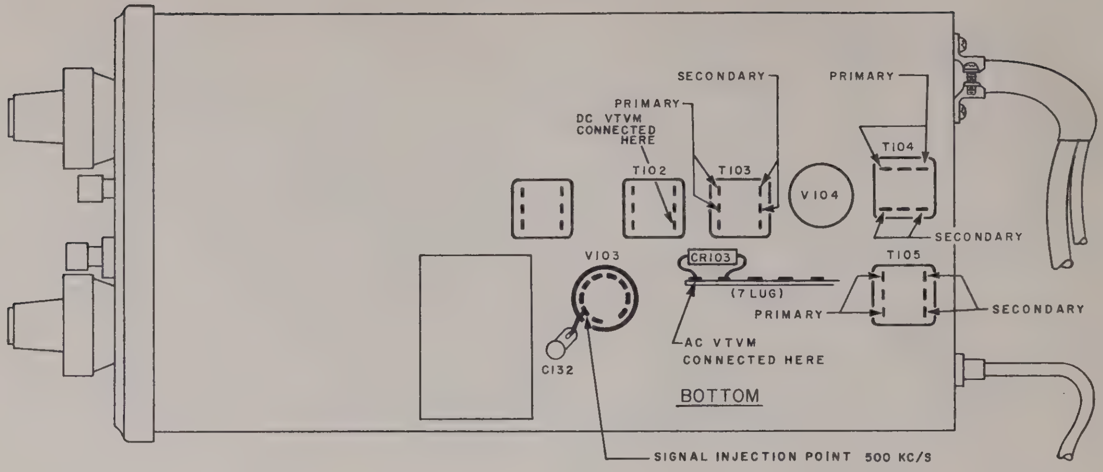


Figure 8.
COM RECEIVER TEST CONNECTIONS
LF IF ALIGNMENT and BANDWIDTH CHECK.

5-F. COM RECEIVER.

5-F,1. Low Frequency IF Amplifier.

a. Connect an AC VTVM to the anode (unbanded end) of CR-103.

b. Connect a DC VTVM to C-117.

c. Remove all connections from Pin 2, V-103. Connect a 47 ohm resistor from Pin 2, V-103 to ground.

Connect a signal generator to Pin 2, V-103. Set the signal generator to 500 Kc/s. Set the signal generator output level to the lowest value which will give a useable negative voltage indication on the DC VTVM (with no signal, the DC VTVM should indicate a positive voltage).

d. Temporarily connect a 33K resistor across the secondary winding of each LF IF transformer, T-103, T-104 and T-105. Keep resistor leads short to avoid regeneration.

e. Adjust the primaries (tuning slugs nearer the chassis) of T-103, T-104 and T-105 for maximum negative voltage indication on the DC VTVM. Reduce the signal generator output as necessary to maintain a minimum useable negative voltage indication.

f. Remove the 33K resistors from the secondary windings, and temporarily attach them to the primary windings of T-103, T-104 and T-105.

g. Adjust the Secondaries (tuning slugs farther from the chassis) of T-103, T-104 and T-105 for maximum negative voltage indication on the DC VTVM. Reduce the signal generator output as necessary to maintain the minimum useable negative voltage indication.

h. Remove the three 33K resistors. Modulate the signal generator 30% with a 400 cps signal. Adjust the signal generator output level to produce a reading of 0.4 Volt RMS on the AC VTVM.

Normal Indication: 75 μv maximum input for 0.4 V A.C.

i. Remove all test equipment and replace all connections to Pin 2, V-103.

5-F,2. LF IF Bandwidth

a. Connect a DC VTVM and signal generator as described in steps b., and c., under F,1., above.

b. Adjust the signal generator output level to produce a useable negative voltage indication on the DC VTVM. Vary the signal generator frequency over the IF passband. The negative voltatge indication should peak approximately 10 Kc/s either side of 500 Kc/s, with 500 Kc/s falling at the bottom of the dip between peaks. Use the DC VTVM reading at this dip as the reference level for bandwith measurement.

c. Increase the signal generator output 6 db (2:1) above the value used in step b. Tune the signal generator frequency above 500 Kc/s until the reference level is obtained on the DC VTVM and note the frequency. Tune the generator below 500 Kc/s until the reference level is again reached and note that frequency. The difference between these two frequencies is the total of 6 db bandwith.

d. Increase the signal generator output level 60 db (1000:1) above the value used in step b., above. Tune the signal generator frequency above and below 500 Kc/s until the reference level is reached, as in step c., above. The difference between these two frequencies is the total 60 db bandwidth.

Normal Indication: 6 db — 30 Kc minimum total bandwidth.
(Figure 14, Page 41) 60 db — 100 Kc maximum total bandwidth.

e. Remove all test equipment and replace all connections to Pin 2, V-103.

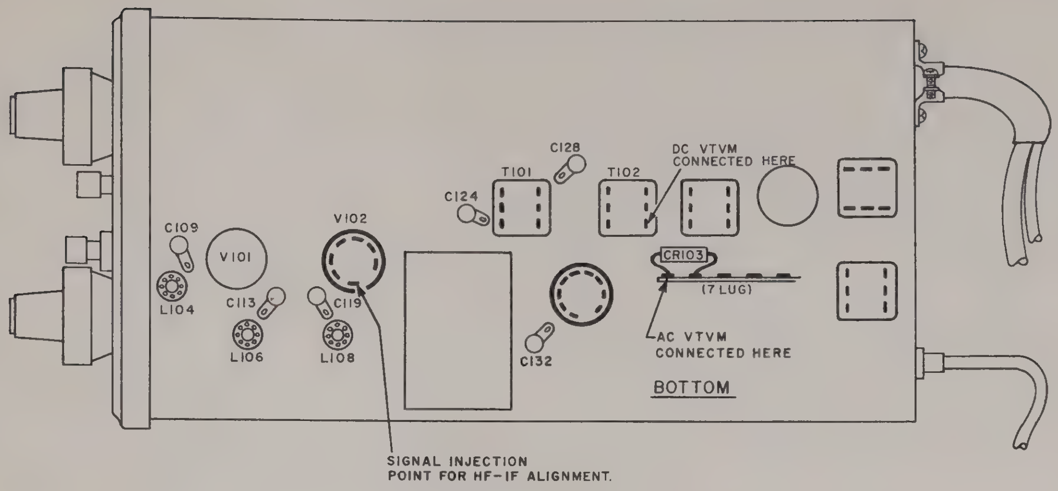


Figure 9.
COM RECEIVER TEST CONNECTIONS
HF IF and RF alignment.

5-F,3. HF IF Amplifier.

a. Connect an AC VTVM to the anode (unbanded) end of CR-103. Connect a DC VTVM to C-117.

b. Remove all connections from Pin 1, V-102. Connect a 47-ohm resistor from Pin 1, V-102, to ground. Connect a signal generator to Pin 1, V-102.

c. Set the fractional megacycle selector to the .00 position. Set the signal generator to 9.475 Mc/s. Increase the signal generator output to the lowest level which will provide a useable negative voltage indication on the DC VTVM. Adjust T-102 and the primary and secondary slugs of T-101 for maximum negative voltage indication on the DC VTVM. Reduce the signal generator level as necessary to maintain minimum useable negative DC Voltage indication. Several peaks may be observed as the slug of T-102 is adjusted. Use the peak position in which the slug is farthest from the chassis.

d. Set the fractional megacycle selector to the .90 position. Set the signal generator to 8.575 Mc/s. Adjust C-132, C-128 and C-124 for maximum negative DC voltage.

e. Repeat steps c., and d., until no further increase in negative DC voltage is obtained.

f. Modulate the signal generator 30% by 400 cps and check each fractional megacycle position for AC voltage on the AC VTVM. See Table V, page 38 for the HF intermediate frequency at each fractional Mc setting.

Normal Indication: 30 μv maximum for 0.4 VAC.

g. Remove the signal generator and 47-ohm resistor from Pin 1, V-102, and replace all connections.

5-F,4. RF Amplifier.

a. Connect an AC VTVM to the anode (unbanded) end of CR-103. Connect a DC VTVM to C-117.

b. Connect a VHF signal generator to J-101, the COM antenna connector.

CAUTION: DO NOT KEY THE TRANSMITTER! TRANSMITTER POWER MAY DAMAGE THE SIGNAL GENERATOR.

c. Set the channel selectors and the signal generator to 118.50 Mc/s. Increase the signal generator output to the lowest level which will produce a useable negative voltage indication on the DC VTVM. Adjust C-109, C-113, and C-119 for maximum negative DC voltage.

d. Set the channel selectors and the signal generator to 135.50 Mc/s. Adjust L-104, L-106, and L-108 for maximum negative DC voltage.

e. Repeat steps c., and d., until no further increase in negative DC voltage is obtained.

f. Modulate the signal generator 30% by 1000 cps. Set the channel selectors and signal generator to 118.50 Mc/s. Increase the signal generator level until the AC VTVM reads 0.4 VAC. Repeat this check with the channel selectors and the signal generator set at 135.50 Mc/s.

Normal Indication: 5 μv maximum input for 0.4 VAC.

5-F,5. Sensitivity and Audio Output.

a. Connect an audio wattmeter to the speaker output.

b. Connect VHF signal generator to J-101. Modulate the signal generator 30% by 1000 cps.

CAUTION: DO NOT KEY THE TRANSMITTER! TRANSMITTER POWER MAY DAMAGE THE SIGNAL GENERATOR.

c. Set the channel selectors and signal generator to 118.00 Mc/s. Set the COM volume control to the middle of its range. Set the NAV volume control fully counterclockwise and pull the knob. Adjust the signal generator output level to produce a 6 db (4:1) difference in audio power readings with and without modulation.

d. Set the COM volume control fully clockwise and adjust the signal generator level (modulated) to produce 3 watts of audio power.

e. Repeat steps c., and d., with the channel selectors and signal generator set at 126.50 and 135.95 Mc/s.

Normal Indication: 2 μv maximum for 6 db signal plus noise to noise at the speaker output.
5 μv maximum for 3 watts at the speaker output.

5-F,6. Squelch Compensation.

a. Connect the VHF signal generator to J-101, the COM antenna connector. Adjust the signal generator. Adjust the signal generator and the Mark-12A to the same frequency.

b. Turn the squelch knob fully counterclockwise (maximum squelch).

c. Increase the signal generator level from zero until audio is heard to break through.

Normal Indication: Input levels of 10 to 25 microvolts should break maximum squelch.

d. If signal level required to break maximum squelch is less than 10 microvolts, shunt R-131 as necessary to increase the level to more than 10 microvolts. If the squelch breaking level is greater than 25 microvolts, replace R-131 with a higher value resistance to reduce the level to less than 25 microvolts.

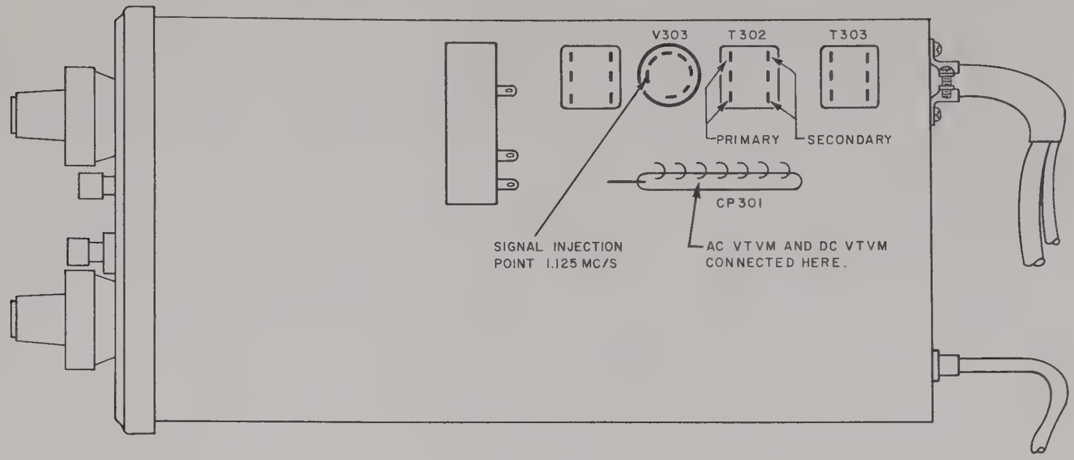

V303
T302
T303
PRIMARY
SECONDARY
CP301
SIGNAL INJECTION POINT 1.125 MC/S
AC VTVM AND DC VTVM CONNECTED HERE.

Figure 10.
NAV LF IF ALIGNMENT CONNECTIONS.

5-G. NAVIGATION RECEIVER ALIGNMENT.

5-G,1. Low Frequency IF Amplifier.

a. Connect an AC VTVM and a DC VTVM to lead 5 of CP-301.

b. Connect an RF-VTVM to the collector of Q-303.

c. Remove all connections from Pin 1, V-303. Connect a 47 ohm resistor from Pin 1 to ground, and connect a signal generator to Pin 1. Set the signal generator to 1.125 Mc/s.

d. Temporarily connect 33K resistors across the primary and secondary windings of T-302. Keep leads short to avoid coupling.

e. Increase the signal generator output to the lowest level which gives a usable negative DC voltage indication on the DC VTVM. Adjust both slugs of T-302 for maximum negative voltage indication, making certain each slug is in the peak position farthest from the center of the transformer. Adjust the primary (slug nearer the chassis) of T-303 for maximum negative DC voltage. Adjust the secondary (slug farther from the chassis) for *minimum* RF voltage on the RF VTVM. Repeat the adjustments of T-303 until maximum negative DC and minimum RF indications are obtained. Both slugs of T-303 must be in the peak positions farthest from the center of the transformer. The correct primary peak is very slight.

f. Remove the two 33K resistors from T-302. Modulate the signal generator 30% by 400 cps. Increase the signal generator output level until a reading of 1.9 volts is obtained on the AC VTVM.

Normal Indication: 200 μv maximum input for 1.9 VAC. (CN144A10, 350 uv max. input.)

g. Remove all test equipment and replace all connections to Pin 1, V-303.

5-G,2. LF IF Bandwidth.

a. Connect a DC VTVM and signal generator as described in steps a., and b., under G,1., above.

b. Adjust the signal generator output to the minimum level which produces a useable negative voltage indication on the DC VTVM. Vary the signal generator frequency across the LF IF passband. The negative voltage indication should peak approximately 10 Kc/s either side of the 1.125 Mc/s center frequency, with 1.125 Mc/s falling at the bottom of a slight dip. The DC VTVM reading at this dip is the reference for LF IF bandwidth measurements.

c. Increase the signal generator output level 6 db (2:1) above the level used in step b. Tune the signal generator above 1.125 Mc/s until the DC VTVM again shows the reference level, and note the frequency. Tune the signal generator below 1.125 Mc/s until the reference level is again reached and note the frequency. The difference between these two frequencies is the total 6 db bandwidth.

d. Increase the signal generator output level 60 db (1000:1) above the level used in step b. Tune the signal generator above and below 1.125 Mc/s until the reference level is reached, as in step c. The difference between these two frequencies is the total 60 db bandwidth.

Normal Indication: 6 db — 38Kc minimum total bandwidth.
(Figure 15, page 41) 60 db — 340 Kc maximum total bandwidth.

e. Remove all test equipment and replace all connections to Pin 1, V-303.

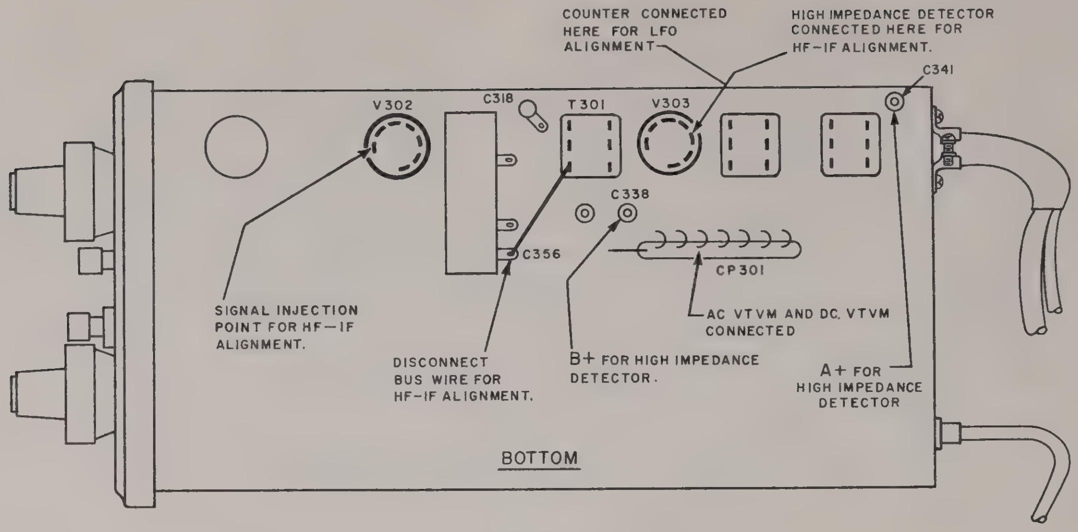

COUNTER CONNECTED HERE FOR LFO ALIGNMENT
HIGH IMPEDANCE DETECTOR CONNECTED HERE FOR HF-IF ALIGNMENT.
C341
V302
C318
T301
V303
C338
C356
CP301
SIGNAL INJECTION POINT FOR HF-IF ALIGNMENT.
AC VTVM AND DC. VTVM CONNECTED
DISCONNECT BUS WIRE FOR HF-IF ALIGNMENT.
B+ FOR HIGH IMPEDANCE DETECTOR.
A+ FOR HIGH IMPEDANCE DETECTOR
BOTTOM

Figure 11.
NAV HF IF and LFO Alignment Connections.

5-G,3. HF IF Amplifier.

a. Disconnect Pin 5, V-303, from T-302. Connect a high-impedance detector (See Fig. 1, Page 17) as follows:
   Connect the B+ lead to C-338.
   Connect the plate lead to Pin 5, V-303.
   Connect the A+ lead to C-341.
   Connect the AC VTVM to the high impedance detector output.

b. Remove all connections from Pin 1, V-302. Connect a 47-ohm resistor from Pin 1, to ground, and connect a signal generator to Pin 1. Modulate the signal generator 30% by 400 cps.

c. Disconnect the buss wire from C-356, then ground the buss wire.

d. Set the fractional megacycle selector to the .9 position. Set the signal generator to 12.35 Mc/s and adjust its output level for a useable indication on the AC VTVM. Adjust both slugs of T-301 for maximum indication on the AC VTVM.

e. Set the fractional megacycle selector to the .0 position. Set the signal generator to 11.45 Mc/s. Adjust C-318 for maximum indication on the AC VTVM.

f. Repeat steps d. and e., until no further increase in AC VTVM indication is obtained.

g. Check the signal generator frequency at which the maximum indication on the AC VTVM is obtained on each fractional megacycle selector position. This frequency should be no more than ±15 Kc from the center frequency given in table VI.

h. Disconnect all test equipment and replace all connections to V-302, V-303 and C-356.

5-G,4. Low Frequency Oscillator.

PRIMARY METHOD

Procedure:

a. Determine that the HF IF is properly aligned.

b. Disconnect Pin 5, V-303 from T-302. Connect a 39 μhy choke from Pin 6, V-303 to Pin 5, V-303. Connect a 47 pf 500V capacitor from Pin 5, V-303 to the input of the frequency counter. Remove all connections from Pin 1, V-302.

c. Set L-314 to mid-range. (Tuning screw half way in). Set C-345 to mid-range. (Slot for tuning tool parallel to the chassis).

d. Set the fractional Mc selector to the .9 position. Observe the frequency indicated on the counter. Adjust L-314 for an indication of 11.225 Mc on the counter.

e. Set the fractional Mc selector to the .0 position. Observe the frequency indicated on the counter. Adjust C-345 for an indication of 10.325 Mc on the counter.

f. Repeat steps d. and e. until the circuit is tracked. Check the frequency of each fractional Mc position. The frequency must be within ±8 Kc of the center frequency of each position. See Table IV, page 37.

g. Reconnect the components previously removed from Pin 1, V-302. Remove the counter, 47 pf capacitor, and 39 μhy choke from Pin 5 and Pin 6 of V-103. Reconnect Pin 5, V-303 to T-302.

ALTERNATE METHOD

Procedure:

a. Calibrate a BC-221 frequency meter to the nearest crystal check point related to the 10 Mc through 11 Mc range.

b. Connect a length of insulated wire (#22 hook up wire is adequate) to the antenna post of the BC-221. Insert the other end of the wire into the plate and screen area of V-303. Take care that the wire is well away from the control grid area of V-303 or oscillator frequency pulling will be experienced.

c. Set the fractional Mc selector to the .9 position. Set the BC-221 to 11.225 Mc. Adjust L-314 for a zero beat from the BC-221.

d. Set the fractional Mc selector to the .0 position. Set the BC-221 to 10.325 Mc. Adjust C-345 for a zero beat from the BC-221.

e. Repeat steps c. and d. until the circuit is tracked. Check the frequency of each fractional Mc position. The frequency must be within ±8 Kc of the center frequency for each position.

Normal Indication:

Each fractional Mc position must be no more than ±8 Kc from its center frequency.

5-G,5. Overall IF Gain.

a. Connect an AC VTVM to lead 5 of CP-301.

b. Remove all connections from Pin 1, V-302. Connect a 47 ohm resistor from Pin 1 to ground and connect a signal generator to Pin 1. Modulate the signal generator 30% by 1000 cps.

c. Set the fractional Mc selector to each of the following positions, and the signal generator to the corresponding frequency. Note the input required to produce 1.9 VAC on the AC VTVM at each frequency.

Fractional Mc Selector	Signal Generator Frequency
.0	11.45 Mc/s
.5	11.95 Mc/s
.9	12.35 Mc/s

Normal Indication: 20μv maximum input for 1.9 VAC detector output.

d. Remove all test equipment and replace all connections to Pin 1, V-302.

5-G,6. High Frequency Oscillator.

a. Connect a RF VTVM probe to Pin 1, V-302.

b. Set the megacycle selector to the 108 position. Adjust C-345 for maximum RF voltage indication.

c. Set the megacycle selector to the 117 position. Adjust L-310 for maximum RF voltage indication.

d. Repeat steps b., and c., until no further increase in RF voltage indication is obtained.

e. Check to insure that the oscillator is operating in each megacycle position. Operation is indicated by a normal RF indication.

Normal Indication: 0.5 V RMS Nominal.
0.3 V RMS Minimum.

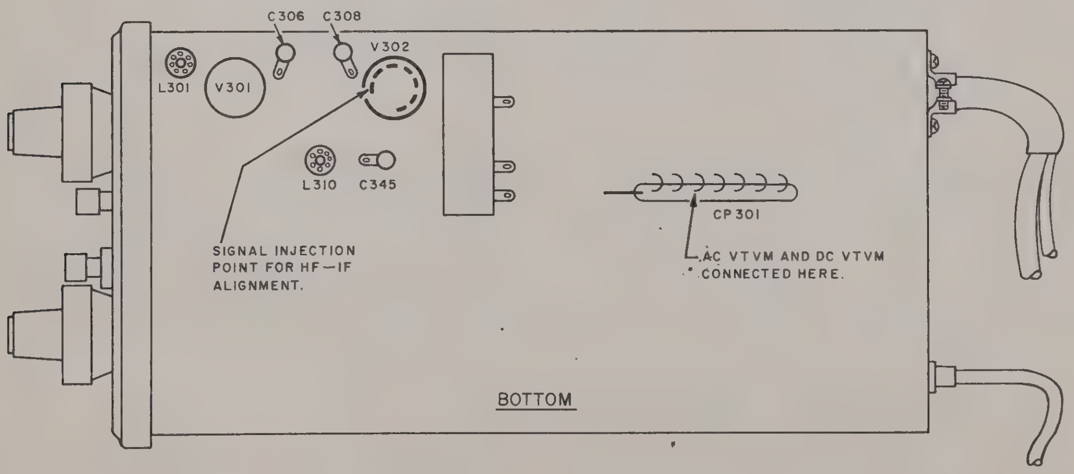

C306
C308
V302
L301
V301
L310
C345
SIGNAL INJECTION POINT FOR HF—IF ALIGNMENT.
CP301
AC VTVM AND DC VTVM CONNECTED HERE.
BOTTOM

Figure 12
NAV HFO and RF Alignment Connections.

5-G,7. RF Amplifier.

a. Connect an AC VTVM and a DC VTVM to lead 5 of CP-301.

b. Connect a VHF signal generator to J-301.

c. Set the channel selectors and signal generator to 108.5 Mc/s. Increase the signal generator output to provide a useable negative voltage indication on the DC VTVM. Adjust C-306 and C-308 for maximum negative DC voltage.

d. Set the channel selectors and signal generator to 117.5 Mc/s. Adjust L-301 for maximum negative DC voltage.

e. Repeat steps c., and d., until no further increase in negative DC voltage is obtained.

f. Modulate the signal generator 30% by 1000 cps. Check the input level required to produce 1.9 VAC on the AC VTVM at 108.0, 112.5 and 117.9 Mc/s.

Normal Indication: 2.5 μv maximum input for 1.9 VAC.

5-G,8. Sensitivity and Audio Output.

a. Connect an audio wattmeter to the speaker output.

b. Connect the signal generator to J-301. Modulate the signal generator 30% by 1000 cps.

c. Set the NAV volume control to the middle of its range, and pull the knob. Set the COM volume control fully counterclockwise. Set the channel selector and signal generator to 108.0 Mc/s. Adjust the signal generator output level so the audio wattmeter reading with modulation is 6 db (4:1) greater than the reading without modulation.

d. Repeat step c., with channel selector and signal generator set at 112.5 Mc/s and 117.9 Mc/s.

Normal Indication: 2μv maximum input for 6 db signal plus noise to noise at speaker output.

e. Turn the NAV volume control fully clockwise. Adjust the signal generator output level to provide 4.5 watts audio output with the channel selectors and signal generator set at 108.0, 112.5 and 117.9 Mc/s.

Normal Indication: 3 μv maximum input for 4.5 watts at speaker output.

5-G,9. Ident. Filter Alignment.

a. Connect an audio wattmeter to the speaker output.

b. Connect a VHF signal generator to J-301. Modulate the signal generator 30% by 1020 cps.

c. Set the channel selectors and signal generator to 117.5 Mc/s. Set the signal generator output level to 500 μv. Pull the NAV volume control knob and adjust it for 3 watts on the audio wattmeter. Push the NAV volume control knob in and adjust L-317 for a minimum indication on the audio wattmeter.

Normal Indication: Audio level should be 50 mw maximum at speaker output with NAV volume control knob pushed in.

5-H. MODULATOR-POWER UNIT.

The only control requiring adjustment is the microphone gain control. It is adjusted at the factory for normal carbon microphones, and should need adjustment only if the MK-12A is to be used with a microphone providing a higher output level. If adjustment is required, proceed as follows:

5-H,1. Recommended Method (Bench Adjustment).

Connect the Mark 12A and T (--) MP-12A to a primary power source. Connect the microphone to the modulator/power and accessory cable. Connect an oscilloscope to C-205 (feed-thru capacitor in left front corner of chassis.)

Connect a 50 ohm, 10 watt, dummy load to the COM antenna jack. If possible, have the pilot speak into the microphone in his normal manner. Turn the gain control fully counterclockwise. Key transmitter and, while speaking into the microphone, adjust the gain control until the positive and negative voice peaks, viewed on the oscilloscope, begin flattening.

5-H,2. Alternate Method (Adjustment in Aircraft).

Connect the microphone to the Mark 12A. Connect the common lead of a Simpson Model 260 VOM, or equivalent, to the Mark 12A chassis. Connect the probe to C-205, (feedthru capacitor in left front corner of the chassis). Set the VOM function selector to "output." Key the transmitter, and while speaking a sustained "ah" into the microphone, adjust the gain control for a reading of 60 to 75 volts on the VOM.

5-I. CONVERSION, 90 to 360 COMMUNICATION CHANNELS.

Caution: The Mark-12A conversion kit, ***narco*** No. EL-3077-503, must be used for this conversion. Mark-12 conversion kits, ***narco*** No. EL-2051, are not acceptable, owing to a different crystal correlation, even though the frequencies stamped on the crystals are the same as those in the Mark-12A kit.

The proper Mark-12A COM HFO crystals bear correlation letters QQ. Mark-12A COM LFO crystals bear correlation letters RR.

5-I,1. Fractional Megacycle Crystals.

a. Installation.

This kit contains ten crystals which are to be installed in the low frequency oscillator crystal assembly. The LFO crystal assembly is located just to the rear of V-103 and V-204. It will be noted that this assembly contains crystals in every other crystal position only on both the top and bottom sides of the chassis.

Viewed from the top, front, install the highest frequency crystal of this kit (9.425 Mc) in the vacant crystal space on the extreme left—*nearest chassis edge.* NOTE: Descending crystal oscillator operating frequency is ascending channel selector frequency; i.e., 9.475 Ms = .00, 8.525 Mc = .95. Install the remaining crystals, in descending frequency order, in the vacant crystal spaces working from left to right. When the top row is completed, five crystals should have been used.

Turn the chassis over. Install the remaining five crystals in the open crystal spaces in the bottom row. Viewed from the bottom, front, install the crystals in descending frequency order working from left to right. Use care in soldering crystal leads to prevent heat damage to the crystal. Do not bend crystal leads at a right angle at the point where they emerge from the crystal case. This could fracture the glass seal.

b. Detent Arrangment.

The fractional Mc detent is located at the rear of the chassis on the top side to the left of T-105 between T-101 and T-102. It will be noted that this detent has a star wheel on each end. On the one end, toward the front of the unit, is a ten position star wheel; on the other end, toward the rear of the unit, a twenty position star wheel. This detent must be reversed, or turned around, so that the twenty position star wheel is toward the front of the unit.

The detent is secured by two screws, and it can be removed from its mounting shaft when these screws are loosened. Before removing the detent, set the fractional Mc selector to a position where the rotor tabs of the crystal assembly or of the HF IF step inductors can be observed. Note, at the same time, the frequency indicated by the fractional Mc dial. This is necessary so that proper indexing can be re-established easily.

Remove the detent spring and the detent roller from the detent assembly. Then loosen the two set screws in the dual star wheel assembly and slide the assembly to the rear of the Unit and off the shaft. In the event there is insufficient space to completely remove the star wheel assembly from the shaft, it will be necessary to remove the "COM" Fractional Mc Knob and loosen the set screws securing the Fractional Mc dial to its shaft. The fractional Mc shaft can then be moved forward enough to remove the star wheel assembly. Turn the star wheel assembly end for end so that the twenty position star wheel is toward the front of the unit, then slide it back on its shaft. Now replace the detent roller and detent spring. Note that the long end of the detent spring shall be retained in position, by placing this end on the inside of the outermost tab on the detent mounting plate. Check the rotor tabs at the chosen reference point for indexing, then secure the set screws in the star wheel assembly. Provide about .005 inch end play between the star wheel assembly and the bushing in the detent mounting plate. If the Fractional Mc Knob and dial have been loosened, re-secure them in their proper position as noted above.

After the final check of the assembly, a small amount of wide temperature range grease should be applied to the spring fulcrum, roller, and star wheel detent teeth.

5-I,2. Whole Megacycle Crystals.

a. Installation.

This kit contains nine crystals which are to be installed in the high frequency oscillator crystal assembly. Viewed from the top, front, the HFO assembly is located on the left side approximately midway between the front and rear of the chassis. It is enclosed in a box. Remove the top and the bottom covers. Each is held in place by two machine screws.

Viewed from the front, top side, it will be noted that the HFO crystal assembly has three empty crystal spaces to the left of its top center, and six empty crystal spaces to the right of its top center. Install these nine crytals in these spaces, in ascending frequency order working from left to right. Ue care in soldering crystal leads to prevent heat damage to the crystal. It may be necessary to remove C-251 and L-218 to install crystals in the last two spaces.

b. Stop Removal.

The top on the Mc selector detent plate at the 126 position must now be broken out. To gain access to this stop, the knobs, mask, and trim panel must be removed. Before disassembly of the front panel, it is well to set the selectors to a reference frequency position for re-assembly. Removal of the front panel assembly will reveal the detent plate, The stop will be located on the rear side at the bottom and center of the detent plate. The stop is merely a lance, approximately 1/16 of an inch wide, in the detent plate itself. Break this stop out, and the Mc selector will channel to the 135 position. Exercise care that the channel selectors indicate the proper channel when the front panel is reassembled.

5-I,3. Post Conversion Check-out.

After the crystals are installed, the detents properly adjusted, and the HFO covers re-assembled, give the radio and operational performance check. Alignment of the HFO, the transmitter, and the receiver RF section should be checked. In the event realignment is necessary, refer to the appropriate part of the alignment procedure section of the ***narco*** Mark-12A Instruction Manual. A new frequency check slip is required for the transmitter which reflects the original plus the new channels that have been activated.

HFO frequency may be checked by inserting a long, slim one-turn pickup loop through one of the trimmer access holes in the oscillator side of the HFO box. LFO frequency may be checked by holding a pickup loop near T-201. LFO frequency should be checked in transmit mode.

5-J. SELECTED COMPONENTS.

The values of two capacitors in the Mark-12A are selected for proper circuit operation.

C-331 is selected to adjust the coupling between windings of T-302, to control the bandwidth of the NAV receiver. Increasing C-331 narrows the receiver bandwidth. This capacitor should range from 0 to 1.5 pF. See Par. 5-G,2, page 29 for bandwidth measurement techniques.

C-335 is selected to permit proper tracking of the NAV low-frequency oscillator. In aligning this oscillator, C-353 may be found to have sufficient range for tracking. The value of C-355 may then be increased or decreased to permit tracking. See Par. 5-G,4, page 30, for NAV LFO alignment procedure.

A resistor may be shunted across R-131, or the value of R-131 may be greater than 33K in some cases. The value of R-131 is thus adjusted for proper squelch operation. See Par. 3-F,6, page 28, for squelch compensation procedure.

5-K. PRODUCTION CHANGES.

5-K,1. Introduction.

The information in this manual is specifically applicable to Mark-12A panel units with chassis number CN144A11. Minor electrical and mechanical differences will be found between the chassis and earlier production units. The following table lists these differences. "X" indicates that a particular chassis will have the indicated circuit changes descibed in the first column.

5-K,2. Table of Chassis Differences.

CURRENT CIRCUIT	Chassis Number CN144											REMARKS
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	
C-236 (33pF dipped mica from Q-203 collector to ground) and L-224 (5.6 μhy between Q-203 collector and T-201) added.	X	X	X	X	X	X	X	X	X	X	X	May be added if internal COM heterdoyne is noted when tuning variable - frequency generator through COM channel.
C-118 changed from .33 pF to .22pF.	—	X	X	X	X	X	X	X	X	X	X	.22pF may be installed to improve COM high frequency image rejection.
C-326 changed from .003 to .01.	—	X	X	X	X	X	X	X	X	X	X	.01 may be installed to suppress power supply harmonics in NAV receiver.
R-333 changed from 22K to 15K.	—	X	X	X	X	X	X	X	X	X	X	15K may be installed to increase NAV output level.
Q-203 Circuit Changes.	—	—	—	—	—	—	—	X	X	X	X	See Fig. 29.
	X	—	—	—	—	—	—	—	—		—	See Fig. 29A.
	—	X	X	X	X	X	X	—	—		—	See Fig. 29B.
R-138 and C-171 added.	—	—	X	X	X	X	X	X	X	X	X	These components may be installed to correct an intermittent COM receiver
Case grounding clip mounted on shield at V-101 socket.	—	—	X	X	X	X	X	X	X	X	X	Clip may be installed to suppress regeneration in COM receiver front end. This may appear to be case noise.
C-131 changed from 2.2 pF to 8.2 pF and C-168 changed from 4.7 pF to 8.2 pF.	—	—	—	X	X	X	X	X	X	X	X	These values may be changed to improve COM low-frequency image rejection.

5-K,2. Table of Chassis Differences (Continued)

CURRENT CIRCUIT	Chassis Number CN144											REMARKS
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	
R-139 added to radio.	—	—	—	X	X	X	X	X	X	X	X	May be added to stop audio squeal when COM receiver is first turned on.
C-246 changed from .01 to 430 pF and L-225 added.	—	—	—	—	—	X	X	X	X	X	X	C-246 may be changed and L-225 added to prevent harmonics of COM LFO from interfering with NAV receiver.
C-370 and R-340 added.	—	—	—	—	—	X	X	X	X	X	X	May be added to reduce heterodynes produced in COM receiver by harmonics of NAV HFO
R-340 changed from 100 ohms to 150 ohms.	—	—	—	—	—	—	X	X	X	X	X	R-340 may be changed to 150 ohms to further suppress NAV HFO harmonics (see above)
White/blue wire from CR-104 to CP-302, lead 4, instead of shielded lead.	—	—	—	—	—	—	—	—	X	X	X	White / blue wire may be disconnected and replaced with shielded lead, shield grounded at diode end only, to reduce audio whine produced by alternator.
C-362 (Part #21552-1) and R-341 (Part #3114-151) added in parallel between CP-302, pin 1 and V-103, pin 8. R-342 Part #31192-220) added from junction of C-329 and C-330 to junction of R-312 and Q-302 emitter.	—	—	—	—	—	—	—	—	—	X	X	C-362 and R-341 may be added to reduce the audio gain dropoff at high temperatures. R-342 may be added to reduce NAV IF noise.
R-301 replaced by L-318 (0.047μH). C-303 changed to 27 pF. L-316 changed to 0.047μH.	—	—	—	—	—	—	—	—	—	—	X	Antenna filter revised between J-301 and L-301 to improve signal to noise ratio in NAV receiver.

SECTION 6

ILLUSTRATIONS

6-A. INTRODUCTION.

This section contains the Tables, Diagrams and Photos that have not been integrated with the text in the various sections.

The Panel and Power Unit Schematics are in the form of "pullout sheets" which can be used while the pages of the text, illustrations, or parts list are open for use.

6-B. TABLES

TABLE I

CRYSTAL FREQUENCY — HFO COMMUNICATION TRANSCEIVER

Channel	Oscillator Fundamental Frequency (Mc)	Oscillator Doubler Frequency (Mc)
117	63.2375	126.475
118	63.7375	127.475
119	64.2375	128.475
120	64.7375	129.475
121	65.2375	130.475
122	65.7375	131.475
123	66.2375	132.475
124	66.7375	133.475
125	67.2375	134.475
126	67.7375	135.475
127	68.2375	136.475
128	68.7325	137.475
129	69.2375	138.475
130	69.7375	139.475
131	70.2375	140.475
132	70.7375	141.475
133	71.2375	142.475
134	71.7375	143.475
135	72.2375	144.475

TABLE II

CRYSTAL FREQUENCY — LFO COMMUNICATION TRANSCEIVER

Channel	Transmit Crystal Frequency (Mc)	Receive Crystal Frequency (Mc)
.00	9.475	8.975
.05	9.425	8.925
.10	9.375	8.875
.15	9.325	8.825
.20	9.275	8.775
.25	9.225	8.725
.30	9.175	8.675
.35	9.125	8.625
.40	9.075	8.575
.45	9.025	8.525
.50	8.975	9.475
.55	8.925	9.425
.60	8.875	9.375
.65	8.825	9.325
.70	8.775	9.275
.75	8.725	9.225
.80	8.675	9.175
.85	8.625	9.125
.90	8.575	9.025
.95	8.525	9.025

TABLE III

CRYSTAL FREQUENCY — HFO NAVIGATION RECEIVER

Channel	Crystal Frequency (Mc)
108	96.55
109	97.55
110	98.55
111	99.55
112	100.55
113	101.55
114	102.55
115	103.55
116	104.55
117	105.55

TABLE IV

NAV Low Frequency Oscillator Frequencies

Channel	Frequency (Mc/s)
.0	10.325
.1	10.425
.2	10.525
.3	10.625
.4	10.725
.5	10.825
.6	10.925
.7	11.025
.8	11.125
.9	11.225

TABLE V

COM High Frequency Channel	Intermediate Frequencies.
.00	9.475
.05	9.425
.10	9.375
.15	9.325
.20	9.275
.25	9.225
.30	9.175
.35	9.125
.40	9.075
.45	9.025
.50	8.975
.55	8.925
.60	8.875
.65	8.825
.70	8.775
.75	8.725
.80	8.675
.85	8.625
.90	8.575
.95	8.525

TABLE VI

NAV High Frequency Channel	Intermediate Frequencies. Center Frequency (Mc/s)
.0	11.45
.1	11.55
.2	11.65
.3	11.75
.4	11.85
.5	11.95
.6	12.05
.7	12.15
.8	12.25
.9	12.35

TABLE VII

P-301 Terminal No.	Wire Color	Wire Size	Circuit Function
1	Grey	#18	Ground
2	Black	#18	+ DC Supply
3	No. Conn.	—	—
4	White/ Blue Tr.	#22	Omni/Loc. Relay
5	Blue	#22	Est. Dim. for VOR
6	Green	#22	Omni Signal

Frequency (Mc)	CONNECTOR PIN No. (P-202)									
	Fractional Mc. (S-310B)					Whole Mc (S-309)				
	F	H	J	K	L	D	A	E	C	B
108.		X			X			X		X
108.1	X	X						X		X
108.2	X		X					X		X
108.3		X	X					X		X
108.4		X		X				X		X
108.5			X	X				X		X
108.6			X		X			X		X
108.7				X	X			X		X
108.8	X			X				X		X
108.9	X				X			X		X
109.		X			X		X			X
110.		X			X		X		X	
111.		X			X				X	X
112.		X			X	X				X
113.		X			X	X			X	
114.		X			X			X	X	
115.		X			X	X		X		
116.		X			X	X	X			
117.		X			X		X	X		
118.		X			X			X		

NOTES

1. Fractional Megacycle sequence (S-301B, 0.1 to 0.9 Mc) repeated for each Mc from 108 to 118 Mc.
2. X signifies that the circuit is at ground potential.

Table ......Channel Selector ground circuits, DME (S-309, S-310B).

Table VIII.
Channel Selector Ground Circuits, DME (S-309, S-310B).

NAV Channel (Mc)	Glide Slope Channel (Mc)	CONNECTOR NO.												
		P-301	P-201											
		4	B	E	A	D	H	L	P	R	N	K	F	C
108.0	—			X										
108.1	334.7	X	X	X	X									
108.2	—			X										
108.3	334.1	X	X	X		X								
108.4	—			X										
108.5	329.9	X	X	X			X							
108.6	—			X										
108.7	330.5	X	X	X				X						
108.8	—			X										
108.9	329.3	X	X	X					X					
109.0	—													
109.1	331.4	X	X							X				
109.2	—													
109.3	332.0	X	X								X			
109.4	—													
109.5	332.6	X	X									X		
109.6	—													
109.7	333.2	X	X										X	
109.8	—													
109.9	333.8	X	X											X
110.0	—													
110.1	334.4	X	X		X									
110.2	—													
110.3	335.0	X	X			X								
110.4	—													
110.5	329.6	X	X				X							
110.6	—													
110.7	330.2	X	X					X						
110.8	—													
110.9	330.8	X	X						X					
111.0	—			X										
111.1	331.7	X	X	X						X				
111.2	—			X										
111.3	332.3	X	X	X							X			
111.4	—			X										
111.5	332.9	X	X	X								X		
111.6	—			X										
111.7	333.5	X	X	X									X	
111.8	—			X										
111.9	331.1	X	X	X										X
112.	—			X*	SEE NOTE BELOW									
113.	—			X*										
114.	—			X*										
115.	—													
116.	—													
117.	—													
118.	—													

NOTES

1. X signifies that the circuit is at ground potential.
2. Since P-301/4 and P-201/B (Columns 3 & 4) control the OMNI/LOC and G/S circuits, they are not grounded when the channel selectors are set above 111.9 Mc. There is grounding of the remaining pins of P-201 as the channel changes are made; however they can be disregarded since the activate leads are not grounded above 111.9 Mc.

Table IX.
Channel Selector Ground Circuits, OMNI/LOC and Glide Slope
(S-310A, S-305A & B, S-312A & B)

6-C. DIAGRAMS.

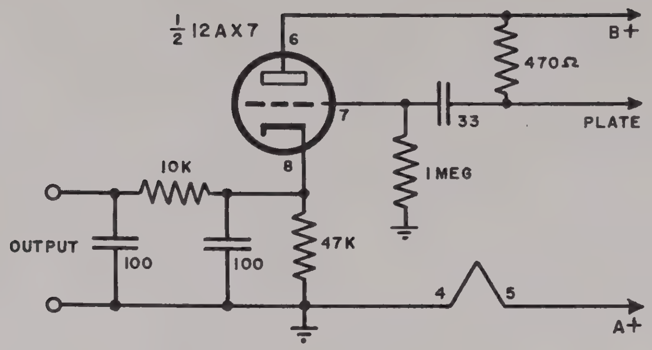

½ 12AX7
6
7
8
B+
470Ω
33
PLATE
10K
1 MEG
OUTPUT
100
100
47K
4
5
A+

Figure 13.
TEST DETECTOR, High Impedance Type.

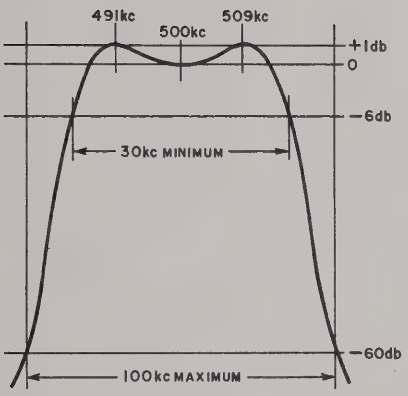


Figure 14.
COM LF IF PASSBAND.

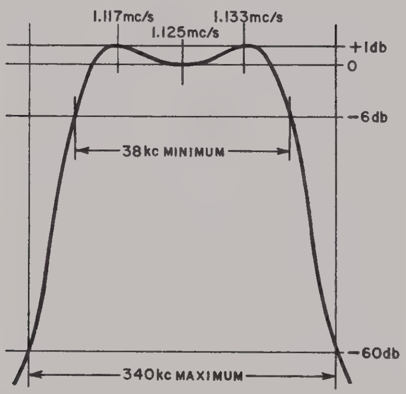


Figure 15.
NAV LF IF PASSBAND.

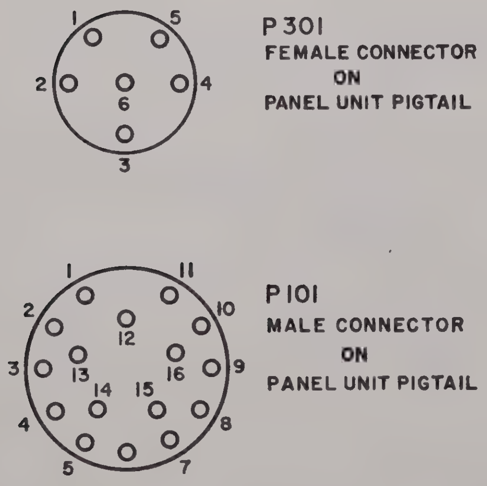

1
2
3
4
5
6
P301
FEMALE CONNECTOR
ON
PANEL UNIT PIGTAIL
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
P101
MALE CONNECTOR
ON
PANEL UNIT PIGTAIL

Figure 16.
CONNECTOR PIN IDENTIFICATION.

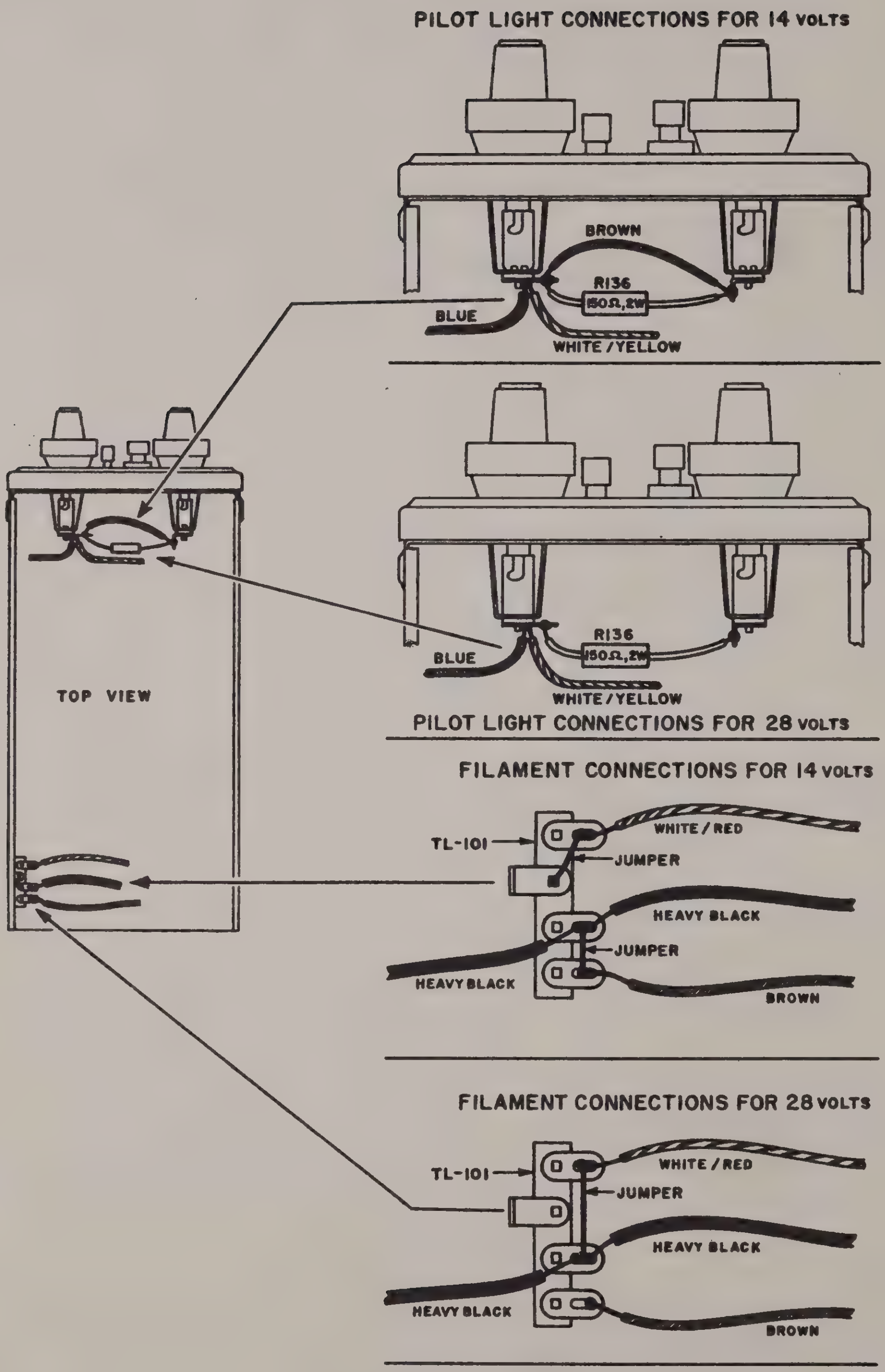
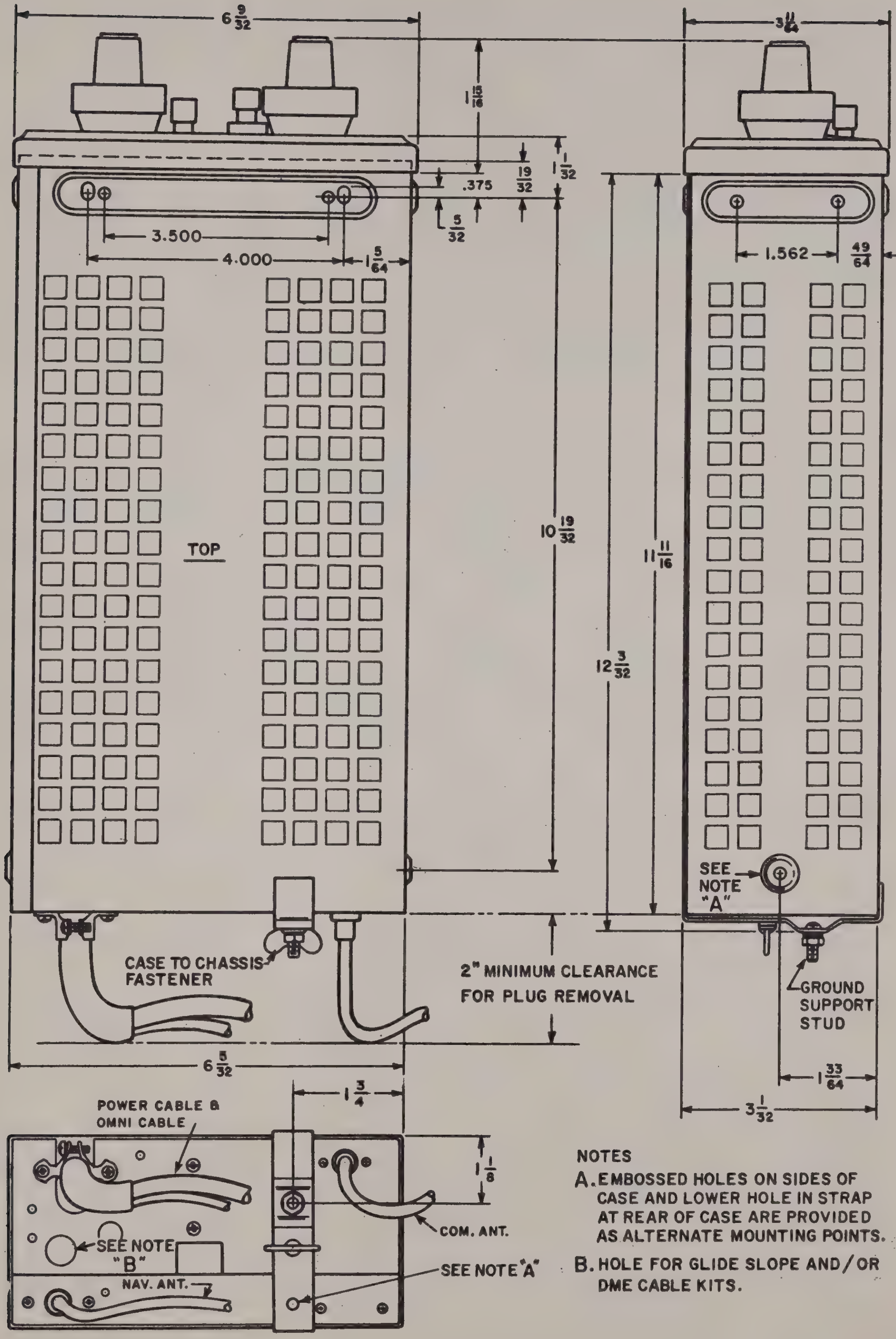

PILOT LIGHT CONNECTIONS FOR 14 VOLTS
BROWN
R136
150Ω, 2W
BLUE
WHITE / YELLOW
TOP VIEW
R136
150Ω, 2W
BLUE
WHITE / YELLOW
PILOT LIGHT CONNECTIONS FOR 28 VOLTS
FILAMENT CONNECTIONS FOR 14 VOLTS
TL-101
WHITE / RED
JUMPER
HEAVY BLACK
JUMPER
HEAVY BLACK
BROWN
FILAMENT CONNECTIONS FOR 28 VOLTS
TL-101
WHITE / RED
JUMPER
HEAVY BLACK
HEAVY BLACK
BROWN

Figure 17.
Voltage Changeover Connections.


6 9/32
3 11/64
1 15/16
1 1/32
19/32
.375
5/32
3.500
4.000
1 5/64
1.562
49/64
TOP
10 19/32
11 11/16
12 3/32
SEE NOTE "A"
CASE TO CHASSIS FASTENER
2" MINIMUM CLEARANCE FOR PLUG REMOVAL
GROUND SUPPORT STUD
6 5/32
1 33/64
3 1/32
1 3/4
POWER CABLE & OMNI CABLE
1 1/8
COM. ANT.
SEE NOTE "B"
NAV. ANT.
SEE NOTE "A"

NOTES

A. EMBOSSED HOLES ON SIDES OF CASE AND LOWER HOLE IN STRAP AT REAR OF CASE ARE PROVIDED AS ALTERNATE MOUNTING POINTS.

B. HOLE FOR GLIDE SLOPE AND/OR DME CABLE KITS.

Figure 18.
narco Mark 12A PANEL UNIT,
Installation Diagram.

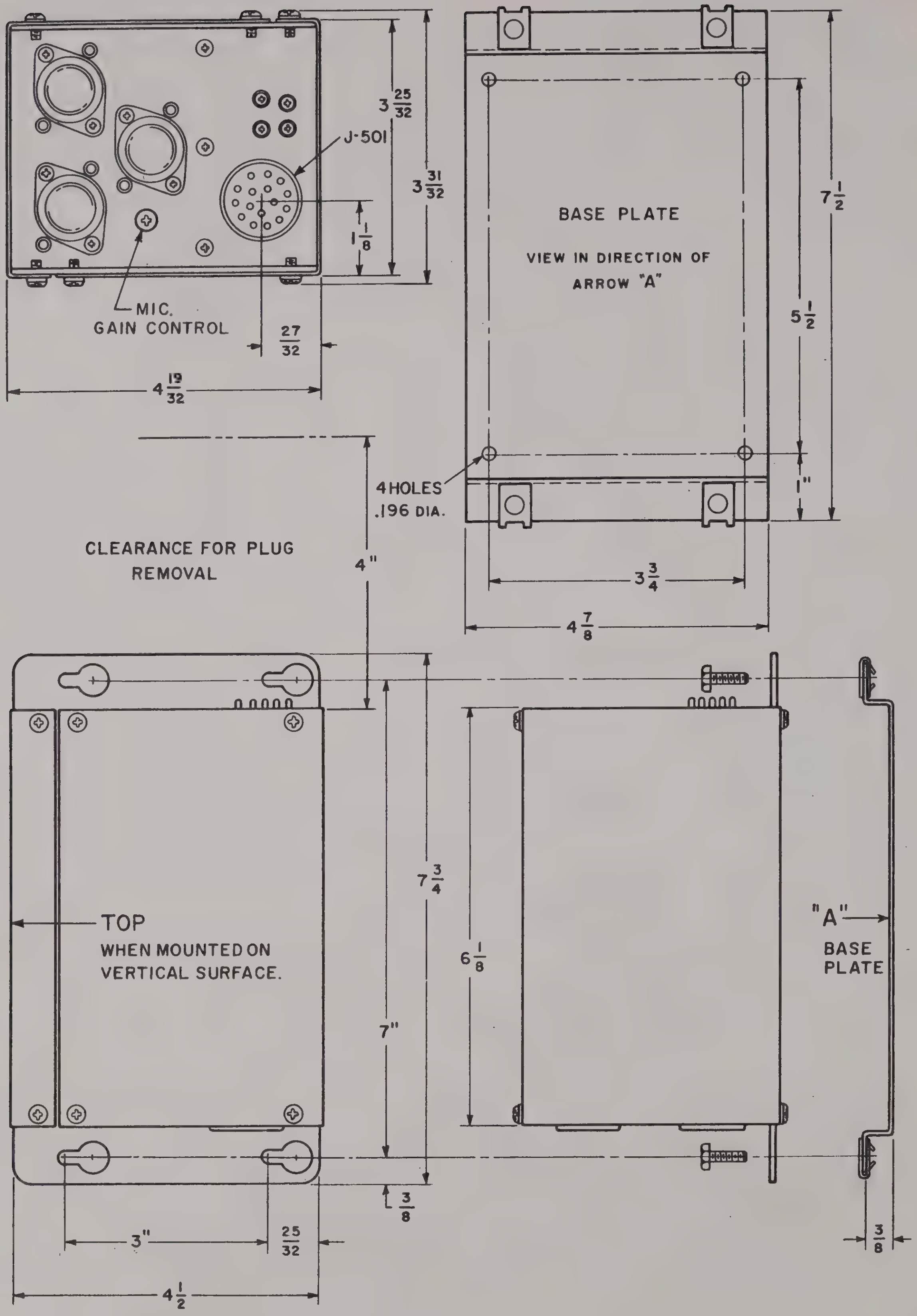
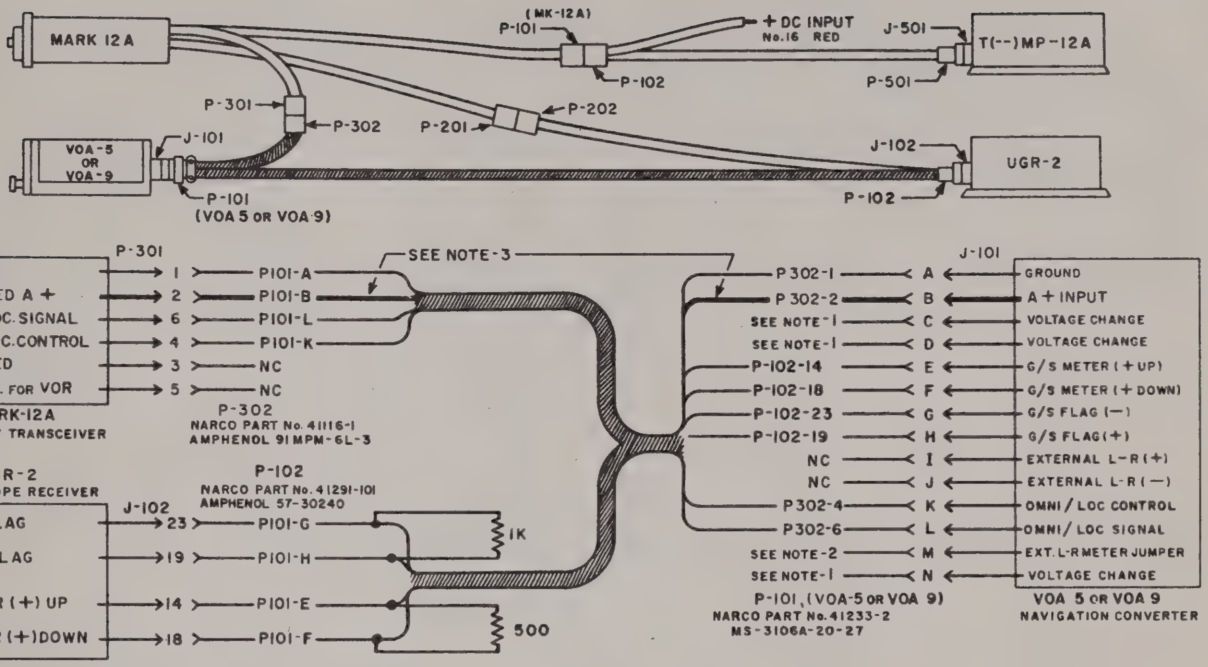

3 25/32
3 31/32
J-501
1 1/8
MIC.
GAIN CONTROL
27/32
4 19/32
BASE PLATE
VIEW IN DIRECTION OF
ARROW "A"
7 1/2
5 1/2
1"
4 HOLES
.196 DIA.
3 3/4
4 7/8
CLEARANCE FOR PLUG
REMOVAL
4"
7 3/4
7"
6 1/8
TOP
WHEN MOUNTED ON
VERTICAL SURFACE.
"A"
BASE
PLATE
3/8
3"
25/32
4 1/2
3/8

Figure 19.
narco T12MP-12A or T24MP-12A Modulator-Power Unit,
Installation Diagram.


MARK 12A
(MK-12A)
P-101
P-102
+DC INPUT
No.16 RED
J-501
P-501
T(--)MP-12A
P-301
P-302
P-201
P-202
VOA-5 OR VOA-9
J-101
P-101 (VOA 5 OR VOA 9)
J-102
P-102
UGR-2
P-301
GROUND
SWITCHED A +
OMNI/LOC. SIGNAL
OMNI/LOC. CONTROL
NOT USED
EXT. DIM. FOR VOR
1
2
6
4
3
5
P101-A
P101-B
P101-L
P101-K
NC
NC
MARK-12A
COM/NAV TRANSCEIVER
P-302
NARCO PART No. 41116-1
AMPHENOL 91MPM-6L-3
SEE NOTE-3
P302-1
P302-2
SEE NOTE-1
SEE NOTE-1
P-102-14
P-102-18
P-102-23
P-102-19
NC
NC
P302-4
P302-6
SEE NOTE-2
SEE NOTE-1
A
B
C
D
E
F
G
H
I
J
K
L
M
N
J-101
GROUND
A + INPUT
VOLTAGE CHANGE
VOLTAGE CHANGE
G/S METER (+UP)
G/S METER (+DOWN)
G/S FLAG (−)
G/S FLAG (+)
EXTERNAL L-R (+)
EXTERNAL L-R (−)
OMNI/LOC CONTROL
OMNI/LOC SIGNAL
EXT. L-R METER JUMPER
VOLTAGE CHANGE
VOA 5 OR VOA 9
NAVIGATION CONVERTER
P-101, (VOA-5 OR VOA 9)
NARCO PART No. 41233-2
MS-3106A-20-27
UGR-2
GLIDE SLOPE RECEIVER
J-102
(−) FLAG
(+) FLAG
METER (+) UP
METER (+) DOWN
23
19
14
18
P-102
NARCO PART No. 41291-101
AMPHENOL 57-30240
P101-G
P101-H
P101-E
P101-F
1K
500

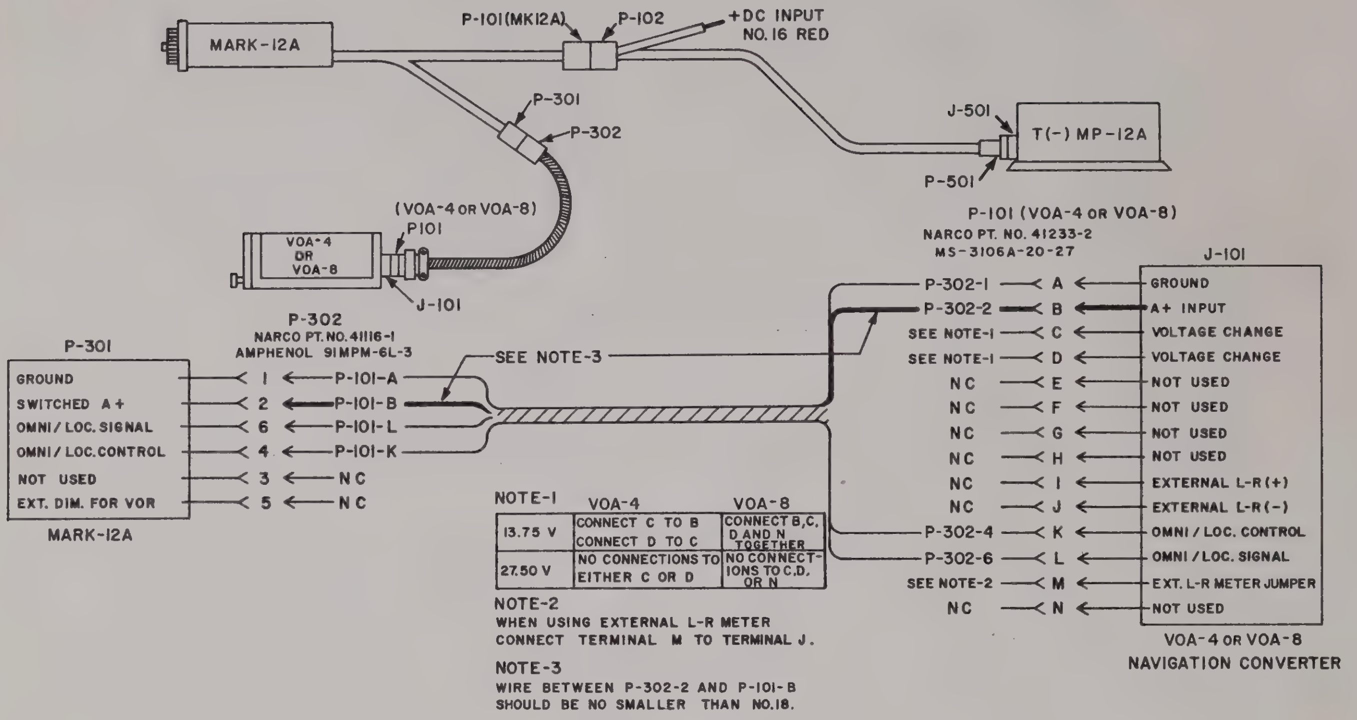
NOTE-1

	VOA-5	VOA-9
13.75V	CONNECT C TO B CONNECT D TO C	CONNECT B, C, D & N TOGETHER
27.50V	NO CONNECTIONS TO C OR D	NO CONNECTIONS TO C, D OR N

NOTE-2
WHEN USING EXTERNAL L-R METER CONNECT TERMINAL "M" TO TERMINAL "J."

NOTE-3
WIRE BETWEEN P302-2 AND P101-B SHOULD BE NO SMALLER THAN No. 18.

Figure 24.
INTERCONNECTIONS.
narco Mark 12A COM/NAV EQUIPMENT with
narco VOA-5/9 NAV CONVERTER and *narco* UGR-2
SLOPE RECEIVER.


MARK-12A
P-101(MK12A)
P-102
+DC INPUT NO.16 RED
P-301
P-302
J-501
T(-) MP-12A
P-501
(VOA-4 OR VOA-8)
P101
VOA-4 OR VOA-8
J-101
P-101 (VOA-4 OR VOA-8)
NARCO PT. NO. 41233-2
MS-3106A-20-27
J-101
P-302
NARCO PT. NO. 41116-1
AMPHENOL 91MPM-6L-3
P-301
GROUND — 1 — P-101-A
SWITCHED A+ — 2 — P-101-B
OMNI/LOC. SIGNAL — 6 — P-101-L
OMNI/LOC.CONTROL — 4 — P-101-K
NOT USED — 3 — NC
EXT. DIM. FOR VOR — 5 — NC
MARK-12A
SEE NOTE-3
P-302-1 — A — GROUND
P-302-2 — B — A+ INPUT
SEE NOTE-1 — C — VOLTAGE CHANGE
SEE NOTE-1 — D — VOLTAGE CHANGE
NC — E — NOT USED
NC — F — NOT USED
NC — G — NOT USED
NC — H — NOT USED
NC — I — EXTERNAL L-R(+)
NC — J — EXTERNAL L-R(-)
P-302-4 — K — OMNI/LOC. CONTROL
P-302-6 — L — OMNI/LOC. SIGNAL
SEE NOTE-2 — M — EXT. L-R METER JUMPER
NC — N — NOT USED
VOA-4 OR VOA-8
NAVIGATION CONVERTER

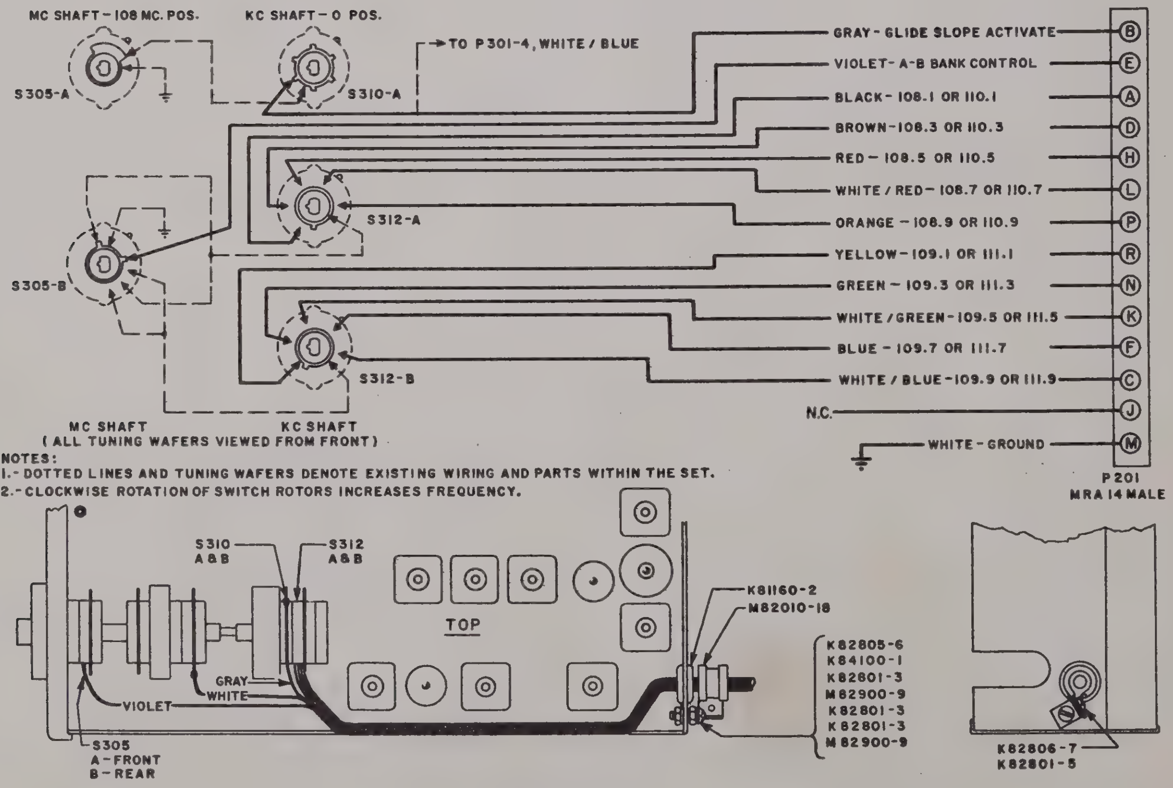
NOTE-1

	VOA-4	VOA-8
13.75 V	CONNECT C TO B CONNECT D TO C	CONNECT B,C, D AND N TOGETHER
27.50 V	NO CONNECTIONS TO EITHER C OR D	NO CONNECTIONS TO C.D. OR N

NOTE-2
WHEN USING EXTERNAL L-R METER CONNECT TERMINAL M TO TERMINAL J.

NOTE-3
WIRE BETWEEN P-302-2 AND P-101-B SHOULD BE NO SMALLER THAN NO.18.

Figure 25.
INTERCONNECTIONS.
narco Mark 12A COM/NAV EQUIPMENT with
narco VOA-6 OMNI CONVERTER.


MC SHAFT-108 MC. POS.
KC SHAFT-0 POS.
S305-A
S310-A
TO P301-4, WHITE/BLUE
S312-A
S305-B
S312-B
MC SHAFT
KC SHAFT
(ALL TUNING WAFERS VIEWED FROM FRONT)
GRAY-GLIDE SLOPE ACTIVATE — B
VIOLET-A-B BANK CONTROL — E
BLACK-108.1 OR 110.1 — A
BROWN-108.3 OR 110.3 — D
RED-108.5 OR 110.5 — H
WHITE/RED-108.7 OR 110.7 — L
ORANGE-108.9 OR 110.9 — P
YELLOW-109.1 OR 111.1 — R
GREEN-109.3 OR 111.3 — N
WHITE/GREEN-109.5 OR 111.5 — K
BLUE-109.7 OR 111.7 — F
WHITE/BLUE-109.9 OR 111.9 — C
N.C. — J
WHITE-GROUND — M
P201
MRA 14 MALE
S310 A&B
S312 A&B
TOP
GRAY
WHITE
VIOLET
S305
A-FRONT
B-REAR
K81160-2
M82010-18
K82805-6
K84100-1
K82801-3
M82900-9
K82801-3
K82801-3
M82900-9
K82806-7
K82801-5

NOTES:
1.- DOTTED LINES AND TUNING WAFERS DENOTE EXISTING WIRING AND PARTS WITHIN THE SET.
2.- CLOCKWISE ROTATION OF SWITCH ROTORS INCREASES FREQUENCY.

Figure 26.
SWITCH WIRING.
narco Mark 12A GLIDE SLOPE CHANNEL SELECTOR

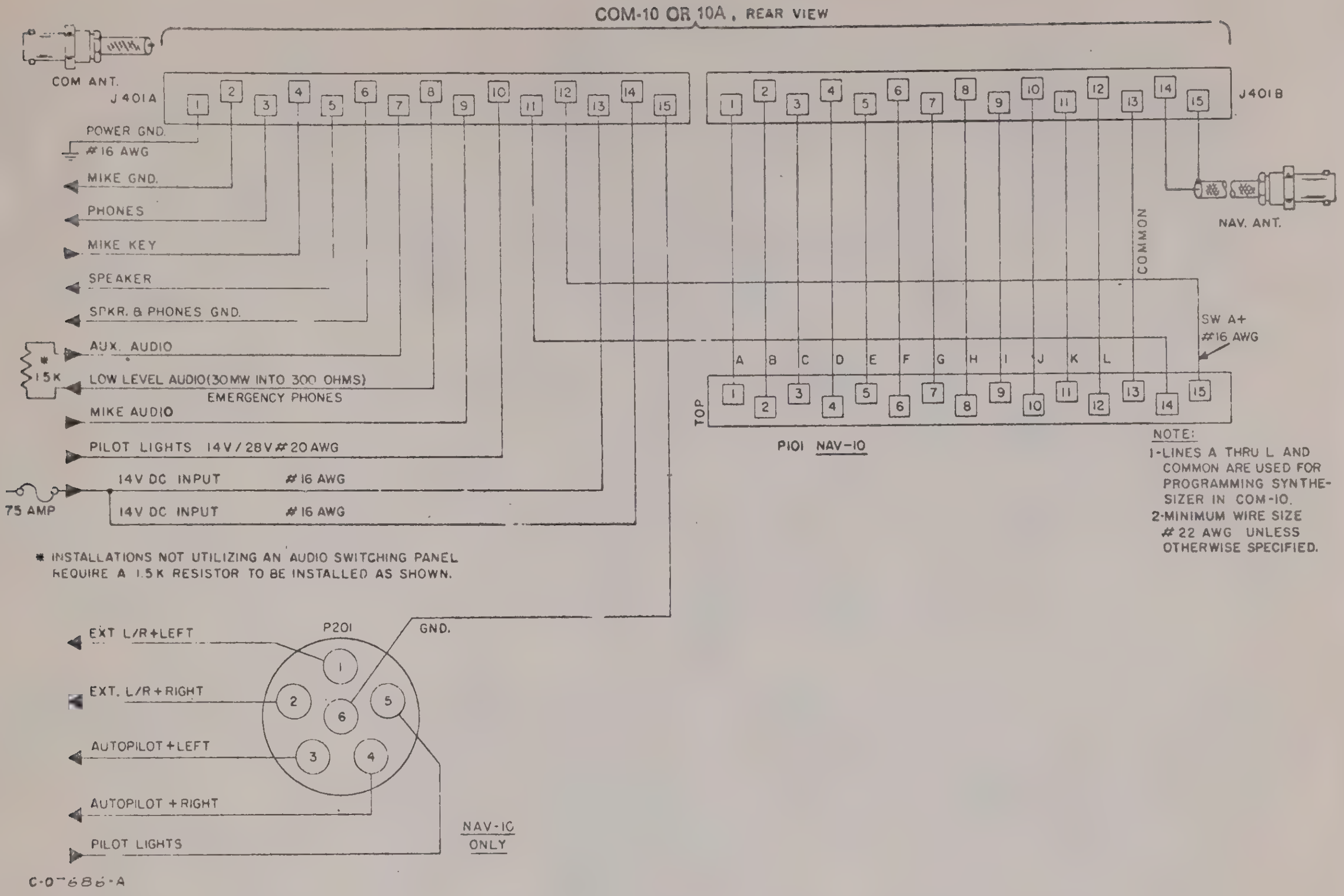
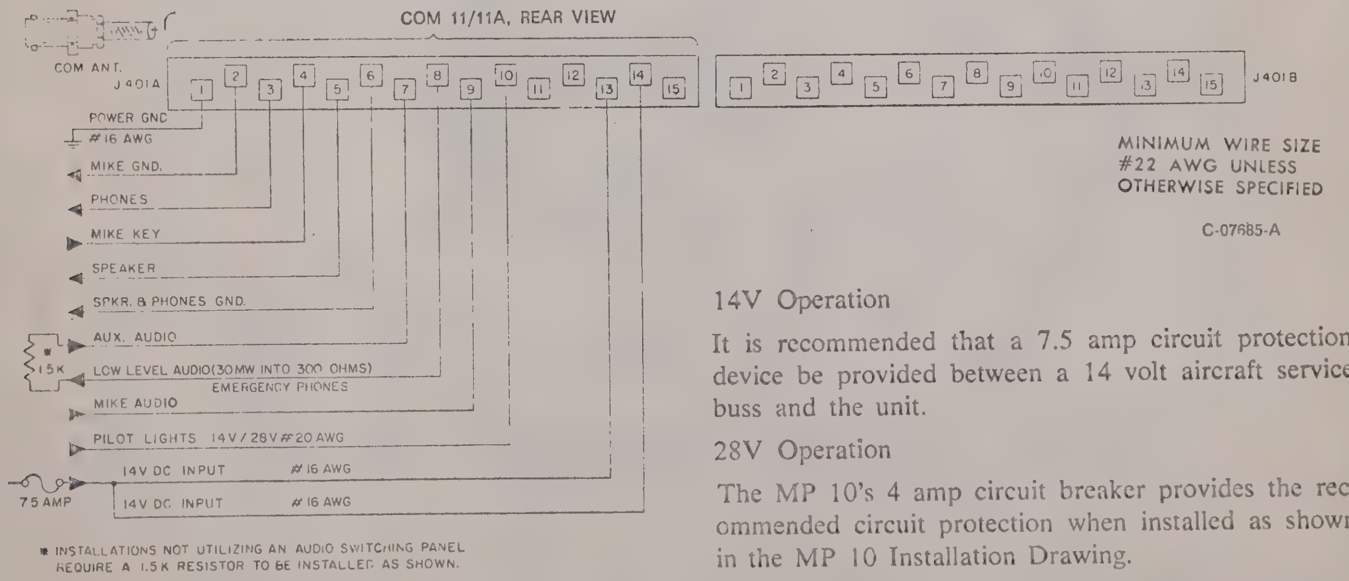

COM-10 OR 10A, REAR VIEW
COM ANT.
J401A
J401B
POWER GND.
#16 AWG
MIKE GND.
PHONES
MIKE KEY
SPEAKER
SPKR. & PHONES GND.
*
1.5K
AUX. AUDIO
LOW LEVEL AUDIO(30MW INTO 300 OHMS)
EMERGENCY PHONES
MIKE AUDIO
PILOT LIGHTS 14V/28V #20 AWG
14V DC INPUT #16 AWG
75 AMP
14V DC INPUT #16 AWG
NAV. ANT.
COMMON
SW A+
#16 AWG
A B C D E F G H I J K L
TOP
P101 NAV-10
NOTE:
1-LINES A THRU L AND COMMON ARE USED FOR PROGRAMMING SYNTHESIZER IN COM-10.
2-MINIMUM WIRE SIZE #22 AWG UNLESS OTHERWISE SPECIFIED.
* INSTALLATIONS NOT UTILIZING AN AUDIO SWITCHING PANEL REQUIRE A 1.5K RESISTOR TO BE INSTALLED AS SHOWN.
P201
GND.
EXT L/R+LEFT
EXT. L/R+RIGHT
AUTOPILOT+LEFT
AUTOPILOT +RIGHT
PILOT LIGHTS
NAV-10 ONLY
1 2 3 4 5 6
C-07686-A

FIGURE 2-8. 14V COM 10 OR 10A/NAV 10 INTERCONNECTION DIAGRAM


COM 11/11A, REAR VIEW
COM ANT.
J401A
J401B
POWER GND
#16 AWG
MIKE GND.
PHONES
MIKE KEY
SPEAKER
SPKR. & PHONES GND.
*
1.5K
AUX. AUDIO
LOW LEVEL AUDIO(30MW INTO 300 OHMS)
EMERGENCY PHONES
MIKE AUDIO
PILOT LIGHTS 14V/28V #20 AWG
14V DC INPUT #16 AWG
75 AMP
14V DC INPUT #16 AWG
* INSTALLATIONS NOT UTILIZING AN AUDIO SWITCHING PANEL REQUIRE A 1.5K RESISTOR TO BE INSTALLED AS SHOWN.
MINIMUM WIRE SIZE #22 AWG UNLESS OTHERWISE SPECIFIED
C-07685-A

14V Operation

It is recommended that a 7.5 amp circuit protection device be provided between a 14 volt aircraft service buss and the unit.

28V Operation

The MP 10's 4 amp circuit breaker provides the recommended circuit protection when installed as shown in the MP 10 Installation Drawing.

See paragraph 2.8.8 for 28v pilot light modification.

FIGURE 2-9. COM 11-11A INTERCONNECTION DIAGRAM

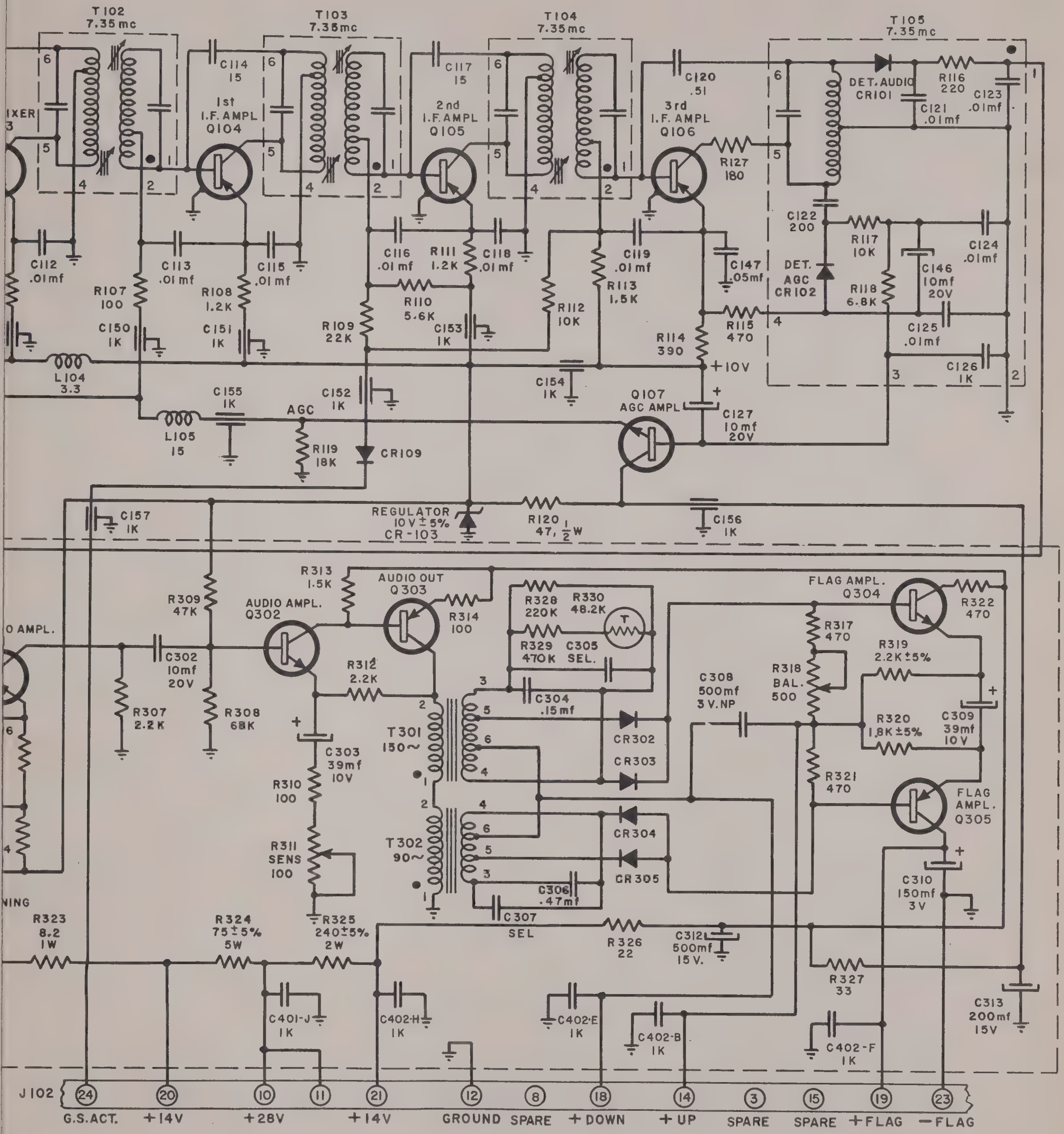
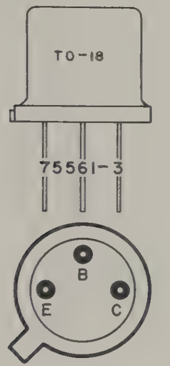
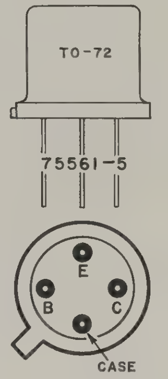

T102
7.35 mc
T103
7.35 mc
T104
7.35 mc
T105
7.35 mc
IXER
C114
15
1st
I.F. AMPL
Q104
C117
15
2nd
I.F. AMPL
Q105
C120
.51
3rd
I.F. AMPL
Q106
DET. AUDIO
CR101
R116
220
C123
.01mf
C121
.01mf
R127
180
C112
.01mf
C113
.01mf
C115
.01mf
C116
.01mf
R111
1.2K
C118
.01mf
C119
.01mf
C147
.05mf
C122
200
R117
10K
C124
.01mf
DET.
AGC
CR102
C146
10mf
20V
R118
6.8K
R107
100
R108
1.2K
R110
5.6K
R112
10K
R113
1.5K
R115
470
C125
.01mf
C150
1K
C151
1K
R109
22K
C153
1K
R114
390
+10V
C126
1K
L104
3.3
C155
1K
C152
1K
C154
1K
Q107
AGC AMPL
C127
10mf
20V
L105
15
AGC
R119
18K
CR109
REGULATOR
10V ± 5%
CR-103
R120
47, 1/2 W
C157
1K
C156
1K
O AMPL.
R313
1.5K
AUDIO OUT
Q303
R314
100
R328
220K
R330
48.2K
R329
470K
C305
SEL.
FLAG AMPL.
Q304
R322
470
R309
47K
AUDIO AMPL.
Q302
C302
10mf
20V
R312
2.2K
R317
470
R319
2.2K ± 5%
R318
BAL.
500
C308
500mf
3 V.NP
C304
.15mf
R307
2.2K
R308
68K
T301
150~
C303
39mf
10V
CR302
CR303
R320
1.8K ± 5%
C309
39mf
10V
R310
100
R321
470
FLAG
AMPL.
Q305
CR304
R311
SENS
100
T302
90~
CR305
C306
.47mf
C310
150mf
3V
NING
R323
8.2
1W
R324
75 ± 5%
5W
R325
240 ± 5%
2W
C307
SEL
R326
22
C312
500mf
15 V.
R327
33
C313
200mf
15V
C401-J
1K
C402-H
1K
C402-E
1K
C402-B
1K
C402-F
1K
J102
24
G.S.ACT.
20
+14V
10
+28V
11
21
+14V
12
GROUND
8
SPARE
18
+DOWN
14
+UP
3
SPARE
15
SPARE
19
+FLAG
23
-FLAG

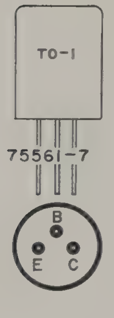
FIGURE 7-2. *narco* UGR-2 GLIDE SLOPE RECEIVER, SCHEMATIC DIAGRAM, SHEET 1

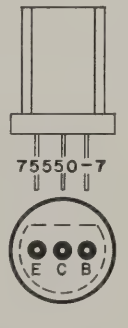

TO-18
75561-3
B
E
C

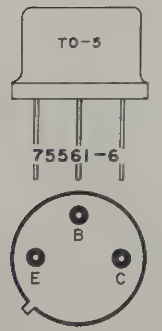

TO-72
75561-5
E
B
C
CASE

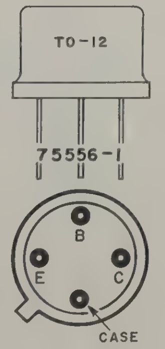
SYMBOL	NARCO PART. NO.
Q-101	75561-5
Q-102	75561-5
Q-103	75556-1
Q-104	75556-1
Q-105	75556-1
Q-106	75556-1
Q-107	75550-7
Q-108	75556-1
Q-109	75556-1
Q-201	75561-6
Q-202	75561-6
Q-203	75561-6
Q-204	75561-6
Q-205	75561-6
Q-206	75561-3
Q-207	75556-1
Q-301	75561-7
Q-302	75550-7
Q-303	75537-2
Q-304	75550-7
Q-305	75561-6

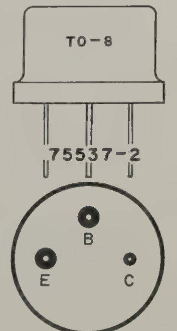
Transistor Identification


TO-1
75561-7
B
E
C

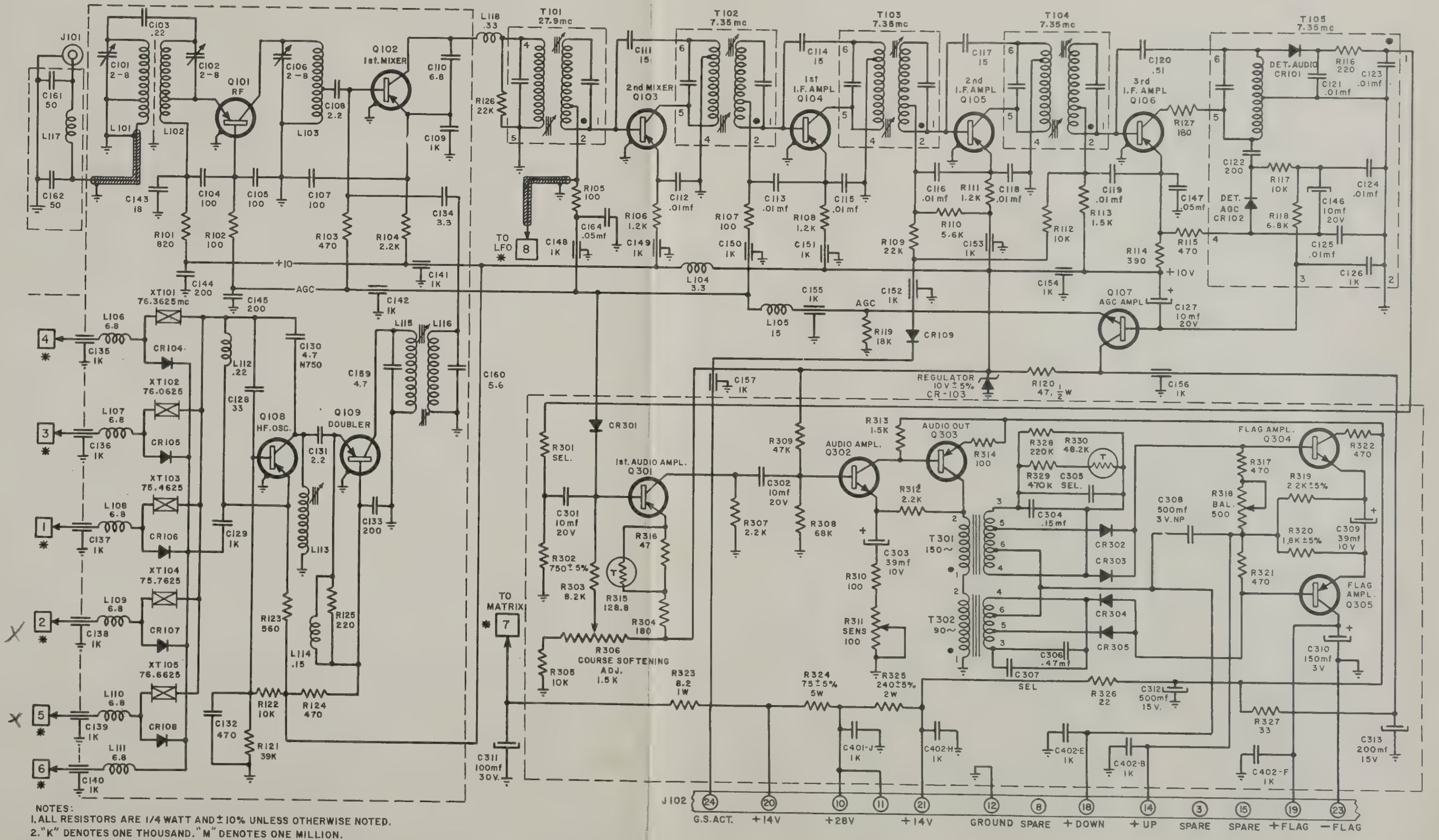



TO-5
75561-6
B
E
C


TO-12
75556-1
B
E
C
CASE


TO-8
75537-2
B
E
C

P-07250


J101
Q101 RF
Q102 1st. MIXER
T101 27.9mc
T102 7.35mc
T103 7.35mc
T104 7.35mc
T105 7.35mc
2nd MIXER Q103
1st I.F. AMPL Q104
2nd I.F. AMPL Q105
3rd I.F. AMPL Q106
DET. AUDIO CR101
DET. AGC CR102
Q107 AGC AMPL
TO LFO 8
AGC
+10
+10V
REGULATOR 10V ± 5% CR-103
CR109
XT101 76.3625mc
XT102 76.0625
XT103 75.4625
XT104 75.7625
XT105 76.6625
CR104
CR105
CR106
CR107
CR108
Q108 HF. OSC.
Q109 DOUBLER
4
3
1
2
5
6
TO MATRIX 7
CR301
1st. AUDIO AMPL. Q301
AUDIO AMPL. Q302
AUDIO OUT Q303
FLAG AMPL. Q304
FLAG AMPL Q305
T301 150~
T302 90~
CR302
CR303
CR304
CR305
R306 COURSE SOFTENING ADJ. 1.5K
R311 SENS 100
R318 BAL. 500
J102
24 G.S.ACT.
20 +14V
10 +28V
11
21 +14V
12 GROUND
8 SPARE
18 +DOWN
14 +UP
3 SPARE
15 SPARE
19 +FLAG
23 -FLAG

NOTES:
1. ALL RESISTORS ARE 1/4 WATT AND ± 10% UNLESS OTHERWISE NOTED.
2. "K" DENOTES ONE THOUSAND. "M" DENOTES ONE MILLION.
3. ALL CAPACITORS ARE IN PICO-FARADS UNLESS OTHERWISE SPECIFIED.
4. ALL INDUCTORS ARE IN MICRO-HENRIES.
5. ✱ NUMBERS IN SQUARES ARE FOR REFERENCE ONLY (SEE T-02221).

T-02222

FIGURE 7-2. *narco* UGR-2 GLIDE SLOPE RECEIVER, SCHEMATIC DIAGRAM, SHEET 1

NARCO AVIONICS

Supplement 1

Place this sheet at the front of the original manual (3077-600) to indicate that Supplement 1 is included in this Maintenance Manual.

MARK 12A

VHF TRANSCEIVER and NAVIGATION RECEIVER
with
T12MP-12A or T24MP-12A MODULATOR-POWER UNIT

MAINTENANCE MANUAL

ISSUE - 1

Supplement – 1, for CN-144-A12, thru CN-144-B6

pages 76 thru 94

NARCO AVIONICS
DIVISION OF NARCO SCIENTIFIC INDUSTRIES
FORT WASHINGTON, PENNSYLVANIA, 19034 U.S.A.

Printed in U.S.A.

January, 1968

MARK 12A

VHF TRANSCEIVER and NAVIGATION RECEIVER

with

T12MP-12A or T24MP-12A MODULATOR-POWER UNIT

MAINTENANCE MANUAL

ISSUE - 1

Supplement – 1, for CN-144-A12, thru CN-144-B6

Remove the front cover sheet and place it at the front of this Mark 12A Maintenance Manual to indicate that the manual has been updated to include all chassis changes up to CN-144-B6.

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NARCO

NARCO AVIONICS
DIVISION OF NARCO SCIENTIFIC INDUSTRIES
FORT WASHINGTON, PENNSYLVANIA, 19034 U.S.A.

INTRODUCTION.

This supplement documents the changes in Chassis Numbers CN-144-A12 thru CN-144-B6 of the Mark 12A VHF Transceiver and Navigation Receiver.

The Replacement Parts List in this supplement provides identification of those parts deleted, added, or changed. The Chassis Number shown indicates when this action took place. When ordering other components, please refer to Section 7 of the original manual.

Upon inserting Figures 32 thru 37, the manual will contain a schematic for each chassis number of the Mark 12A wherein electrical modifications were accomplished.

PRODUCT MODIFICATION SUMMARY

CN-144-A12 and CN-144-B

No electrical or mechanical changes. Factory procedures resulted in chassis number changes.

CN-144-B1, Figure 32 of Supplement 1

Resistor R-239 added to the COM LFO buffer/amplifier Q-203 to provide better stability while in the operating mode.

CN-144-B2, Figure 33 of Supplement 1.

Original parts C-109 and C-119 become unavailable. New parts (two 22019-1) were substituted; however, it was necessary to parallel C-109 with a second capaciator C-172 (PN 21201-239) as well as paralleling C-119 with C-173 (PN 21201-239) to obtain the required capacitance.

Choke coil L-313 was changed to a lower tolerance (±5%) unit for easier tracking of the NAV LFO.

CN-144-B3, Figure 34 of Supplement 1.

Capacitor C-370 removed, C-344 and C-346 relocated grounds to Q-301 case ground, and other related rewiring. Details covering this "birdie-fix" change is found elsewhere in this supplement.

CN-144-B4, Figure 35 of Supplement 1.

Capacitor C-344 changed to PN 24049-180 (18 pf). Capacitor C-346 changed to PN 24049-360 (36 pf).

Due to change in B-3 chassis, it was found that tuning elements C-345 and L-310 in the NAV HFO were running out of range for a clean peak.

Added C-275 across C-251 COM HFO to make up for slight variations of L-218.

CN-144-B5, Figure 36 of Supplement 1.

Removed C-371, a 1000 pf capacitor, and inserted a new capacitor P/N 21281-2 (470 pf) and identified it as C-372. This change eliminated the low frequency "growl" in the NAV receiver due to bleed thru of the 90/150 cycle modulation on localizer channels.

CN-144-B6, Figure 37 of Supplement 1.

Capacitor C-344 changed to P/N 24049-220 (22 pf). Capacitor C-346 changed to P/N 24049-430 (43 pf). This change provided improved range of C-345 and L-310 (NAV HFO).

CN-144-B3 "BIRDIE-FIX"

In the Mark 12A, Chassis Numbered below CN-144-B3, spurious beats developed within the receiver caused interference when tuned to some combinations of Communication and Navigation Channels. A combination of harmonics from the NAV and COM HFO were heterodyned in the NAV mixer to produce undesired beats. This interference has been minimized in all Chassis above CN-144-B3.

Photo L shows the NAV HFO circuit before the modification (Chassis Nos. below B3) and Photo M shows the NAV HFO circuit after modification (Chassis Nos. B3 and above).

The following procedure is given to modify the chassis to incorporate this "birdie-fix":

NOTE

> Photos L and M show all applicable parts. Refer to these figures for BEFORE and AFTER views of the underside of the chassis.

1. Remove C-370 (base/emitter of Q-301, NAV HFO)
2. Relocate the ground points of C-347 and C-343 to the same location as the transistor shield (capacitor lead lengths should be almost equal with capacitors flat against the chassis). Note lead dress of C-347 from the switch wafer through the shield area to ground.
3. Install ground strap on HFO cover (remove two screws from cover and use to secure ground strap, Narco parts 54514-1 and 56455-1, as shown in Figure M.

GENERAL UPDATE

Inadvertantly the basic maintenance manual was produced containing several minor errors. Please refer to your manual and make the following corrections:

Page 8, paragraph 1-B, 4. Navigation Receiver
change Overall Selectivity to:
6 db (nose), ±20 Kc/s minimum bandwidth
60 db (skirt), ±95 Kc/s maximum bandwidth

Page 26, paragraph 5-F ,1h
change to: Normal Indication: 300 μv maximum input for 0.4 VAC.

Page 30, paragraph 5-G, 3a
change to: (See Fig. 13, page 41).

Page 30/31, paragraphs 5-G, 4c, e, and alternate method d.
change references to C-345, to: C-353 (3 places).

Page 34, paragraph 5-J.
Change C-335 in third subparagraph to: C-355 (2 places).

Page 46, Figure 22 Title
Change Narco VOA-4 to VOA-6

Page 48, Figure 25 Title
Change Narco VOA-6 to VOA-4/5.

Page 66/67, change XT 101 thru XT 139 to XT 201 thru XT 239.

Page 67, change XT 140 thru XT 149 to XT 301 thru XT-310 plus change application from: COM Transceiver, to: NAV Receiver.

REPLACEMENT PARTS LIST

The below list of parts supplements the Replacement Parts List (Section 7) and provides the support information resulting from changes made in chassis numbered CN-144-A12 thru CN-144-B6. When ordering these parts from NARCO AVIONICS, please list the chassis number and the source used to obtain the part number (supplement parts list).

MISCELLANEOUS MECHANICAL PARTS

Part Number	DESCRIPTION	Reference
1441-403	Knob, COM	(see figure 1)
1441-404	Knob, NAV	(see figure 1)
88160-2	Knob, COM/NAV Fractional	(see figure 1)
1444-102	Base Plate, Power Unit	(see figure 19)
61481-1	Shaft and Detent Assy Mc NAV	(see photo A and C)
1441-618	Shaft, Kc	(see photo C)
1441-616	Shaft, Mc tuning COM side	(see photo A and C)
1441-610	NAV LFO SUB-ASSY	(see photo K)
1441-628	NAV LFO SUB-ASSY (Less Crystals)	(see photo K)
54514-1	Spring, ground	(used on CN-144-B3 and above)
56455-1	Strap, ground	(used on CN-144-B3 and above)
61503-1	Switch, Rotary, Power ON/OFF	(see photo A)

ELECTRICAL PARTS

Symbol	Narco Part No.	DESCRIPTION	Starting with Chassis Number
C-109 (changed)	22019-1	Capacitor, Variable, Plunger, 0.5-4.5 pf, 500V	CN-144-B2
C-119 (changed)	22019-1	Capacitor, Variable, Plunger, 0.5-4.5 pf, 500V	CN-144-B2
C-172 (added)	21201-239	Capacitor, Ceramic, tub., 3.3 pf ±10%, 500V, NPO	CN-144-B2
C-173 (added)	21201-239	Capacitor, Ceramic, tub., 3.3 pf ±10%, 500V, NPO	CN-144-B2
C-275 (added)	24516-229	Capacitor, Disc, Ceramic, 2.2 pf ±0.5%, 500V	CN-144-B4
C-344 (changed)	24049-108	Capacitor, Disc, Ceramic, 18 pf ±5%, 500V	CN-144-B4
C-344 (changed)	24049-220	Capacitor, Dipped Mica, 22 pf ±5%, 500V	CN-144-B6
C-346 (changed)	24049-360	Capacitor, Dipped Mica, 36 pf ±5%, 500V	CN-144-B4
C-346 (changed)	24049-430	Capacitor, Dipped Mica, 43 pf ±5%, 500V	CN-144-B6
C-370 (removed)			CN-144-B3
C-372 (added)	21291-2	Capacitor, Disc, Ceramic, 470 pf ±10%, 500V	CN-144-B5
L-313 (changed)	11138-28	RF Choke, Insulated, 0.47 uH ±5%	CN-144-B2
R-239 (added)	31192-683	Resistor, Fixed, Carbon, 68KΩ ±10%, 1/4w	CN-144-B1

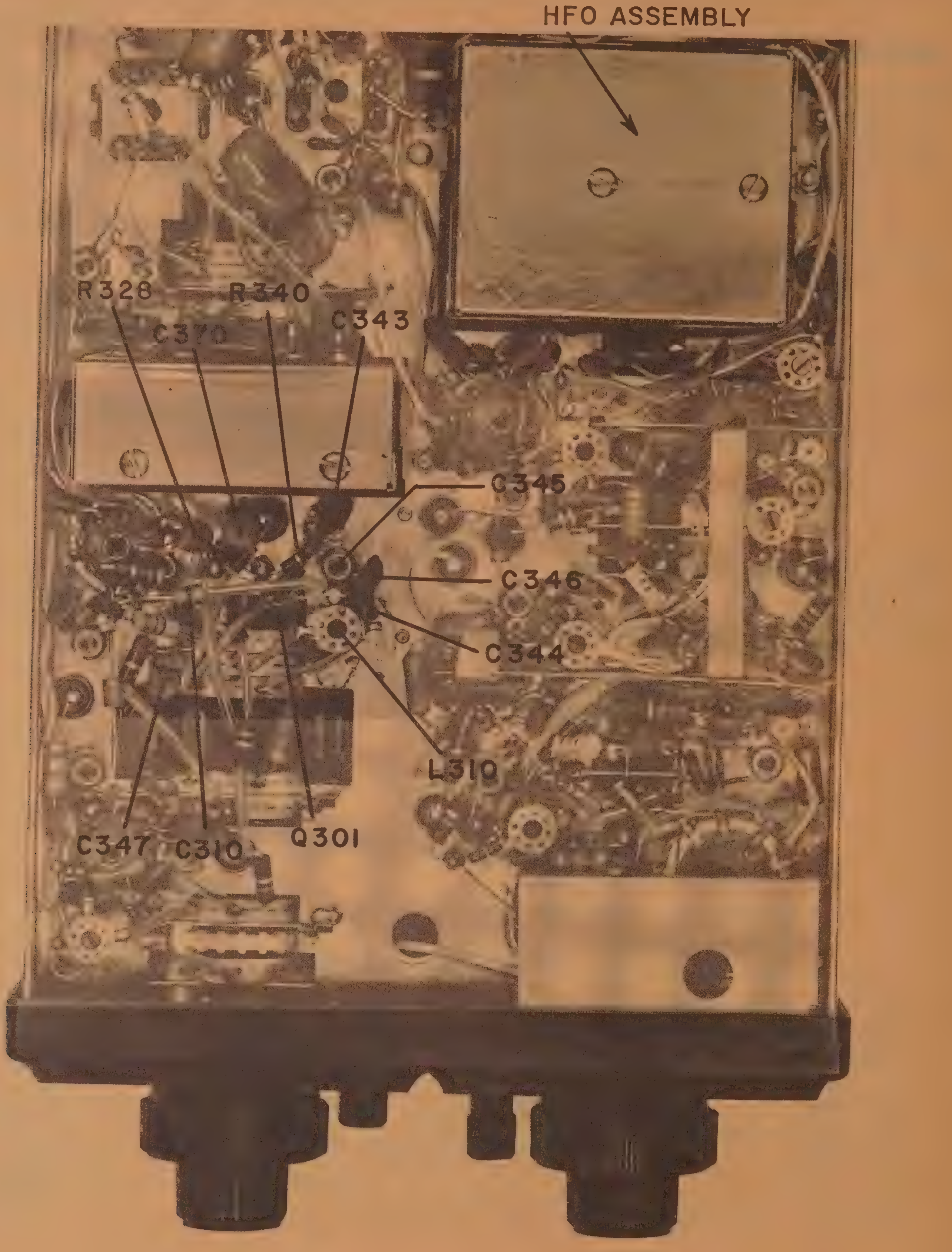

HFO ASSEMBLY
R328
R340
C370
C343
C345
C346
C344
L310
C347
C310
Q301

FIGURE L. BEFORE CONVERSION

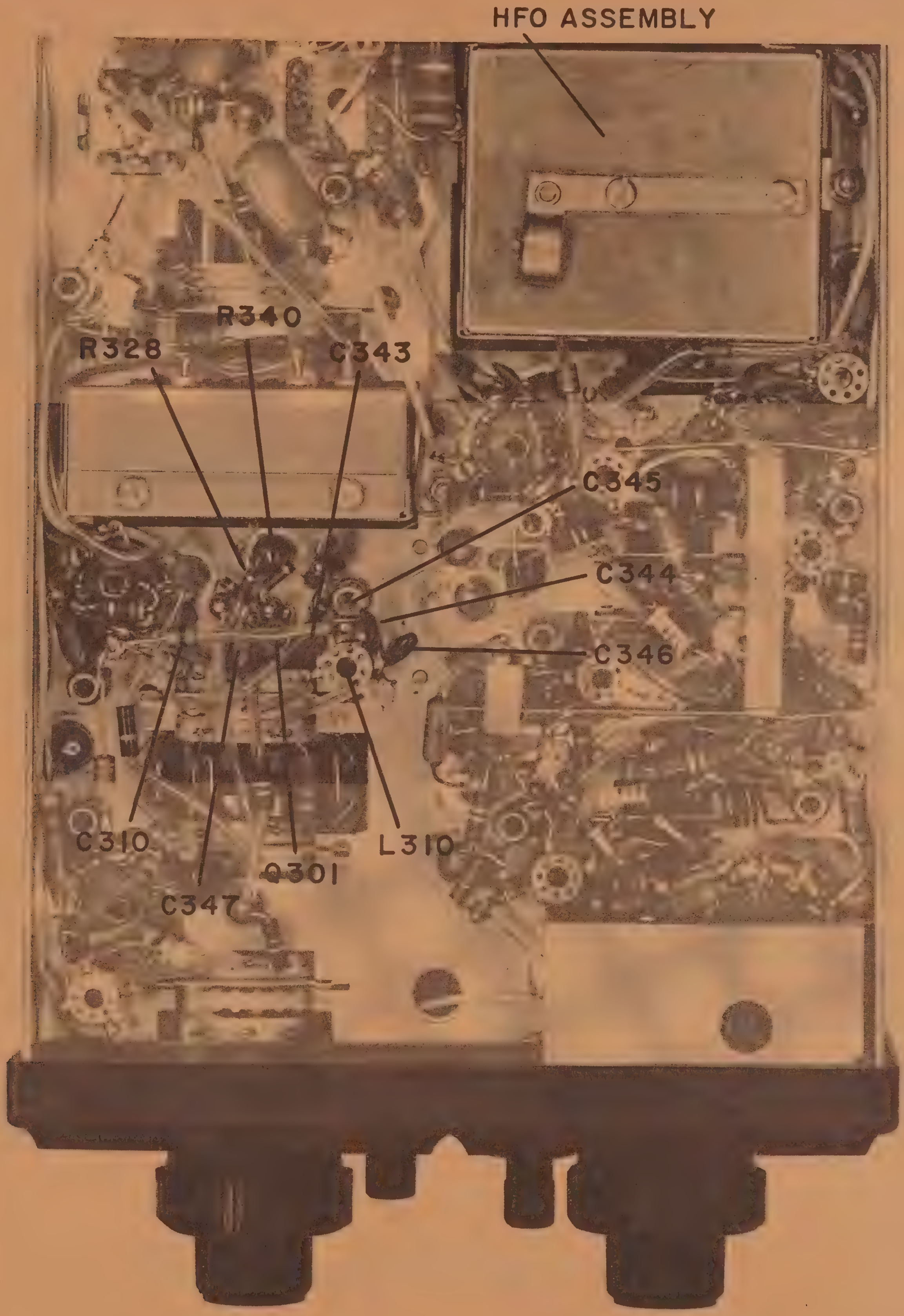
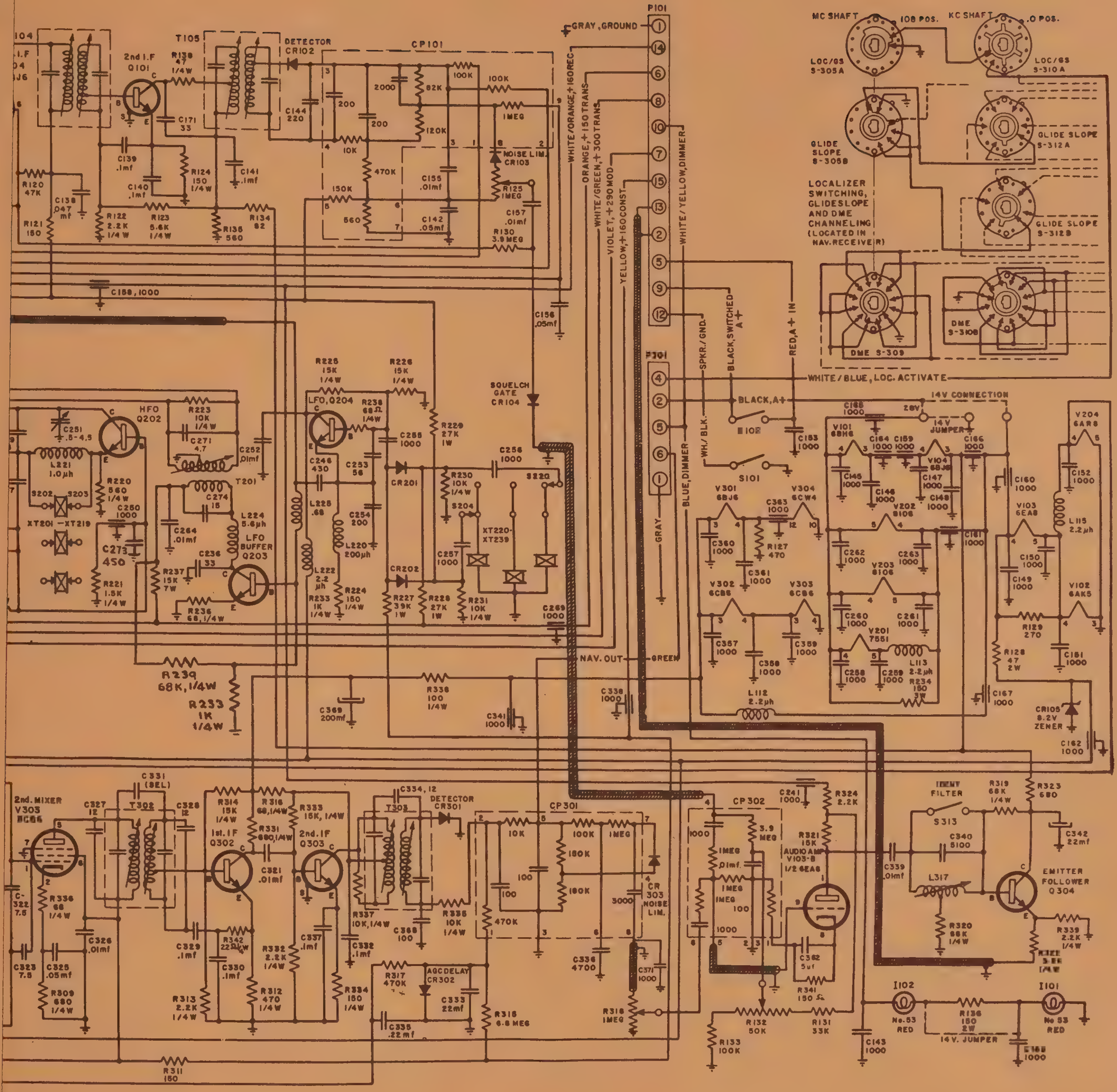
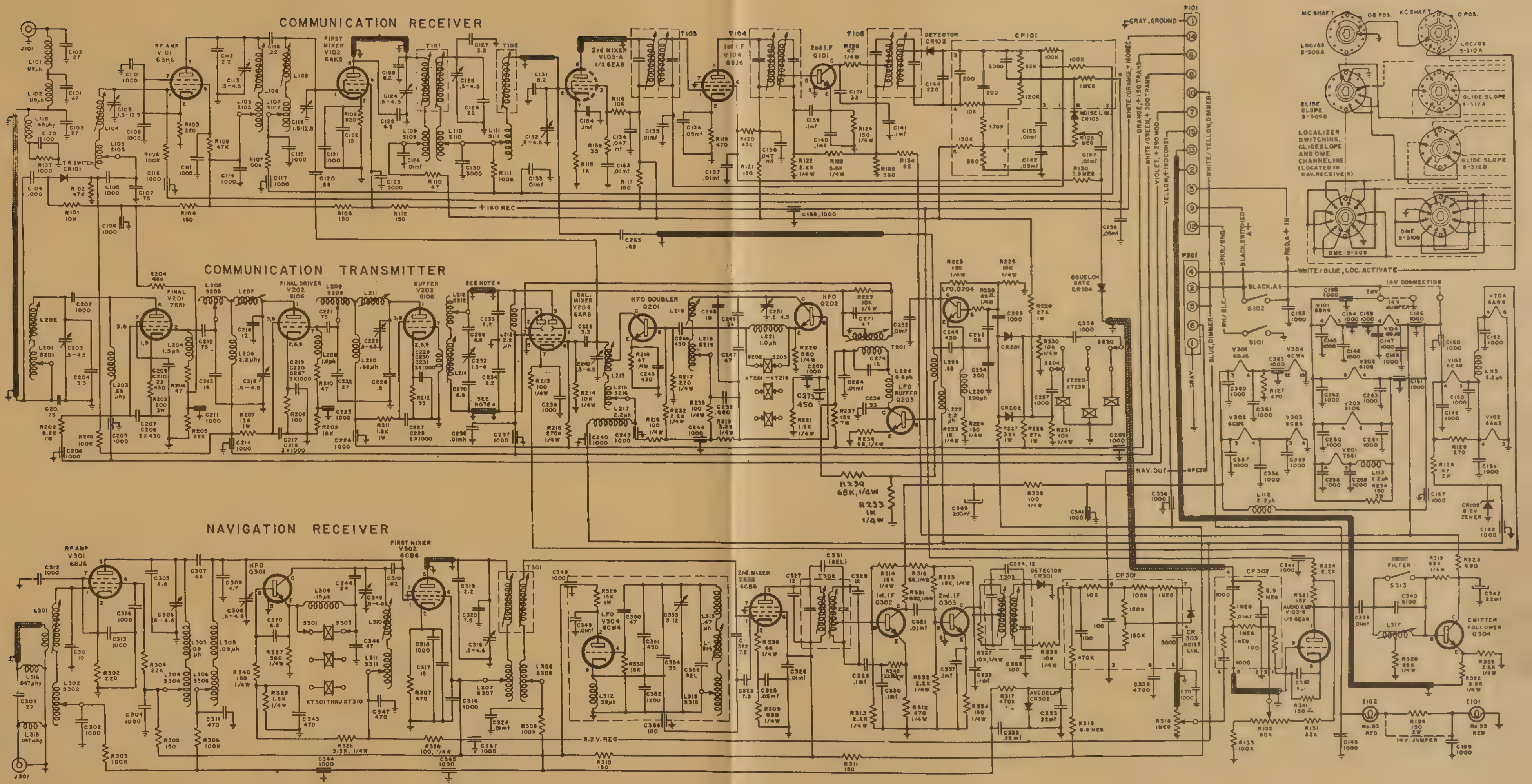

HFO ASSEMBLY
R340
R328
C343
C345
C344
C346
C310
L310
Q301
C347

FIGURE M. AFTER CONVERSION

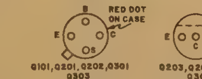

P101
GRAY, GROUND
T105
DETECTOR CR102
CP101
2nd I.F Q101
WHITE/ORANGE,+160REC.
ORANGE,+150 TRANS.
WHITE/GREEN,+300 TRANS.
VIOLET,+290 MOD.
YELLOW,+160 CONST.
WHITE/YELLOW,DIMMER
NOISE LIM. CR103
C158, 1000
SQUELCH GATE CR104
SPKR./GND.
BLACK,SWITCHED A+
RED,A+ IN
WHITE/BLUE, LOC. ACTIVATE
BLACK,A+
14V CONNECTION
14V JUMPER
28V
S102
S101
WH./BLK.
BLUE, DIMMER
GRAY
GREEN
NAV. OUT
P301
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
GLIDE SLOPE S-312B
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-309
DME S-310B
HFO Q202
LFO, Q204
LFO BUFFER Q203
T201
XT201 -XT219
XT220-XT239
CR201
CR202
S202
S203
S204
S220
R239 68K, 1/4W
R233 1K 1/4W
V101 6BH6
V301 6BJ6
V304 6CW4
V302 6CB6
V303 6CB6
V202 8106
V203 8106
V201 7551
V104 6BJ6
V204 6AR5
V103 6EA8
V102 6AK5
CR105 8.2V ZENER
2nd. MIXER V305 6CB6
T302
T303
C331 (SEL)
1st. IF Q302
2nd. IF Q303
DETECTOR CR301
CP301
CP302
CR 303 NOISE LIM.
AGC DELAY CR302
AUDIO AMP V103-B 1/2 6EA8
IDENT FILTER
S313
L317
EMITTER FOLLOWER Q304
I102 No. 53 RED
I101 No. 53 RED
14V. JUMPER
R311 150

*See Figure 29 for test points and service data.

FIGURE 32. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B1


COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
RF AMP V101 6BH6
FIRST MIXER V102 6AK5
2nd MIXER V103-A 1/2 6EA8
1st I.F V104 6BJ6
2nd I.F Q101
DETECTOR CR102
CP101
P101
FINAL V201 7551
FINAL DRIVER V202 6106
BUFFER V203 6106
BAL. MIXER V204 6AR8
HFO DOUBLER Q201
HFO Q202
LFO Q204
LFO BUFFER Q203
SQUELCH GATE
NAV. OUT
RF AMP V301 6BJ6
HFO Q301
FIRST MIXER V302 6CB6
LFO V304 6CW4
2nd. MIXER V303 6CB6
1st. I.F Q302
2nd. I.F Q303
DETECTOR CR301
CP301
CP302
AUDIO AMP V103-B 1/2 6EA8
EMITTER FOLLOWER Q304
+160 REC
8.2 V. REG
J101
J301
J102
J101
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-305
14V. JUMPER
GRAY, GROUND
WHITE/ORANGE,+160 REC
ORANGE,+150 TRANS
WHITE/GREEN,+300 TRANS
VIOLET,+160 REC
YELLOW,+160 CONST.
WHITE/YELLOW,DIMMER
WHITE/BLUE, LOC. ACTIVATE
SEE NOTE 4

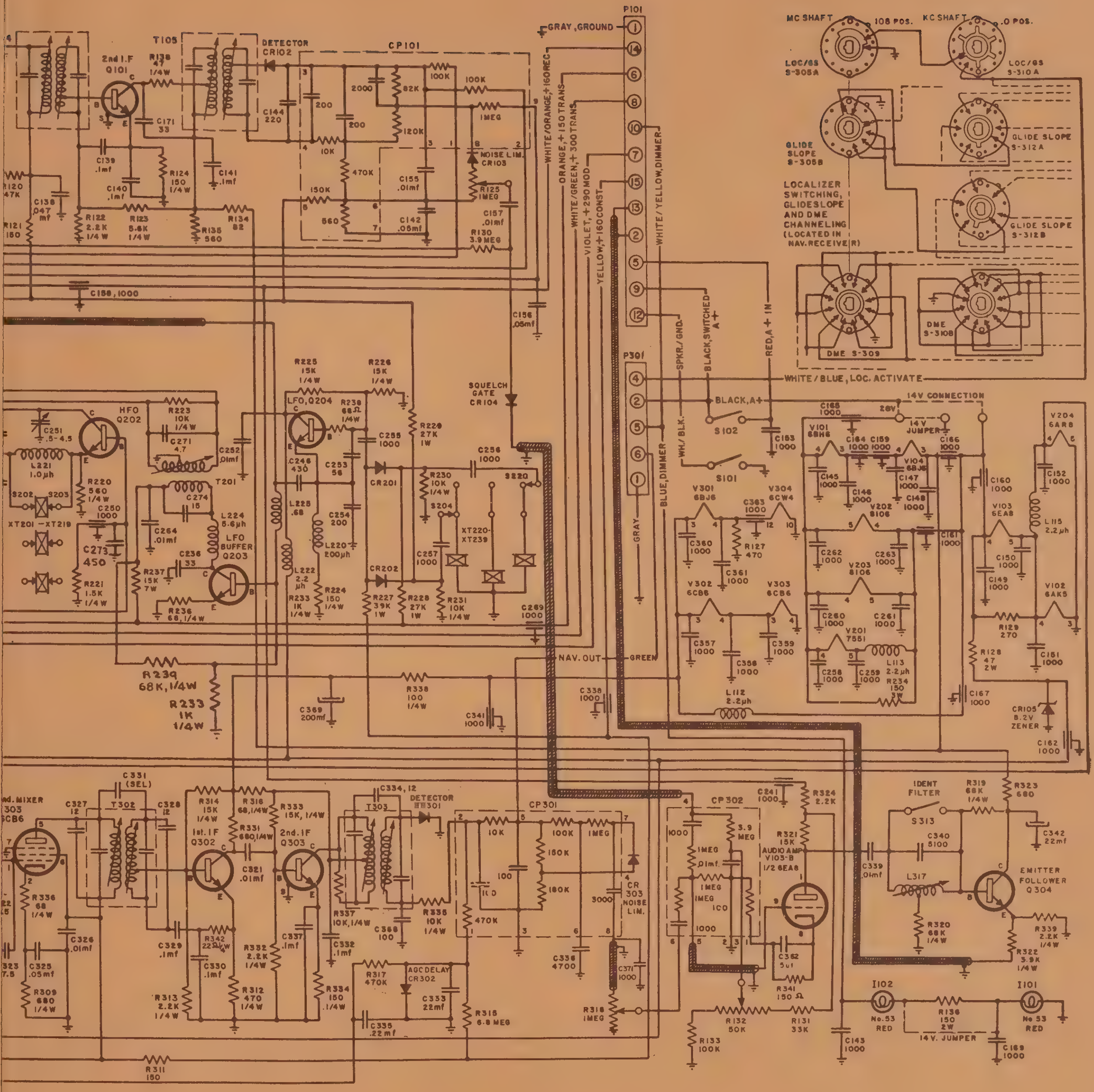
NOTES:
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 5 7/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.


B
RED DOT ON CASE
E
C
S
Q101, Q201, Q202, Q301 Q303
E
C
B
Q203, Q204, Q302 Q304

TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

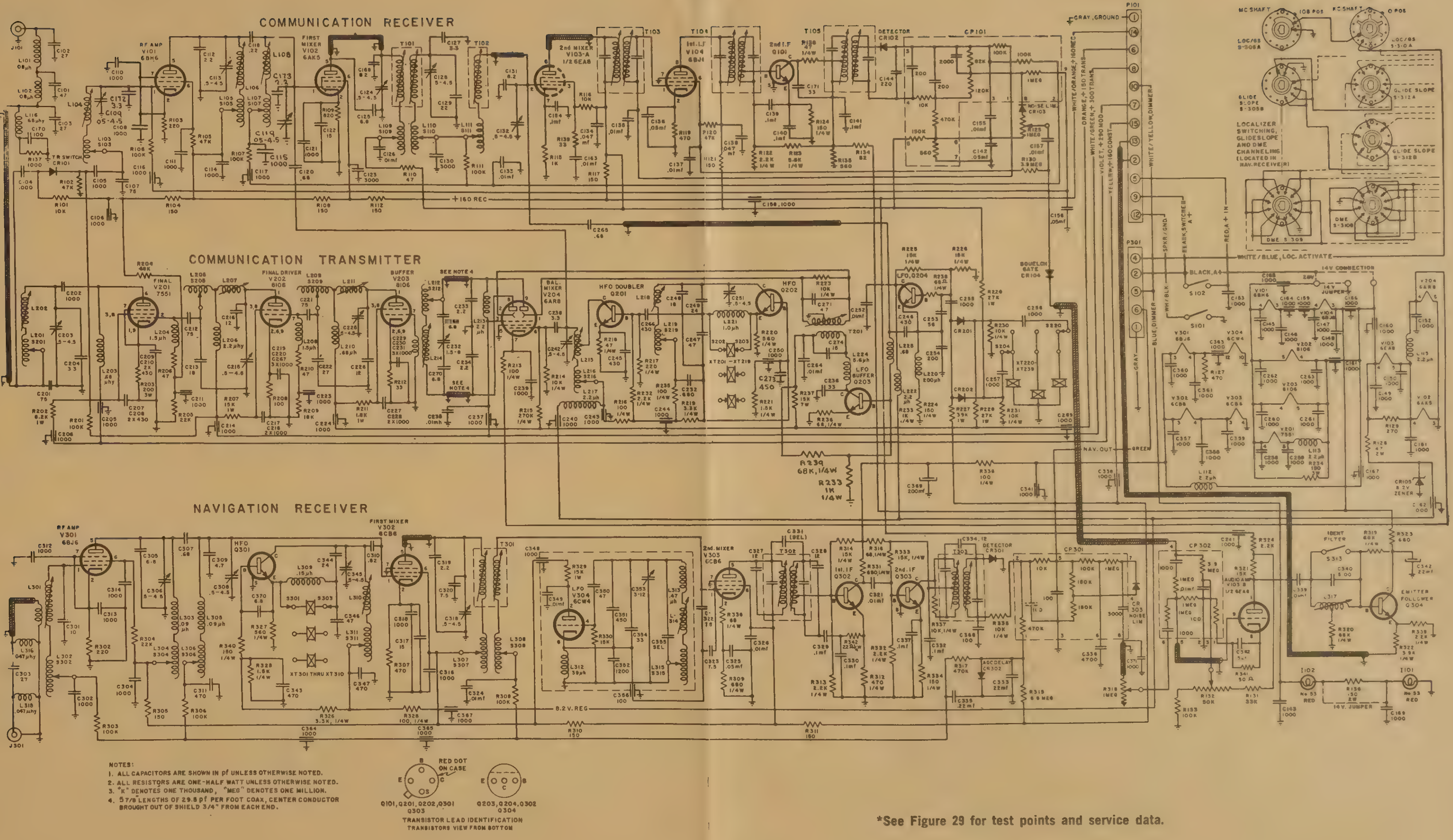
*See Figure 29 for test points and service data.

FIGURE 32. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B1


P101
GRAY, GROUND
WHITE/ORANGE, +160 REC.
ORANGE, +150 TRANS.
WHITE/GREEN, +300 TRANS.
VIOLET, +290 MOD
YELLOW, +160 CONST.
WHITE/YELLOW, DIMMER
BLUE, DIMMER
GRAY
SPKR./GND.
BLACK, SWITCHED A+
RED, A+ IN
WH./BLK.
P301
WHITE/BLUE, LOC. ACTIVATE
BLACK, A+
14V CONNECTION
28V
14V JUMPER
S102
S101
NAV. OUT
GREEN
T105
2nd I.F Q101
R138 47 1/4W
C171 33
DETECTOR CR102
CP101
C144 220
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9 MEG
C139 .1mf
C140 .1mf
R124 150 1/4W
C141 .1mf
C138 .047 mf
R120 47K
R121 150
R122 2.2K 1/4W
R123 5.6K 1/4W
R135 560
R134 82
C155 .01mf
C142 .05mf
C158, 1000
C156 .05mf
SQUELCH GATE CR104
R225 15K 1/4W
R226 15K 1/4W
HFO Q202
LFO, Q204
R223 10K 1/4W
C271 4.7
C251 .5-4.5
L221 1.0µh
R220 560 1/4W
C250 1000
S202
S203
XT201 - XT219
C273 450
R221 1.5K 1/4W
T201
C274 15
L224 5.6µh
C264 .01mf
LFO BUFFER Q203
C236 33
R237 15K 7W
R236 68, 1/4W
C252 .01mf
R239 68Ω 1/4W
C246 430
C253 56
C255 1000
R229 27K 1W
C256 1000
S220
CR201
R230 10K 1/4W
S204
XT220-XT239
L225 .68
C254 200
L220 200µh
C257 1000
CR202
L222 2.2 µh
R233 1K 1/4W
R224 150 1/4W
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
R239 68K, 1/4W
R233 1K 1/4W
R338 100 1/4W
C369 200mf
C341 1000
C338 1000
MC SHAFT
108 POS.
KC SHAFT
0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
GLIDE SLOPE S-312B
DME S-310B
DME S-309
V101 6BH6
C168 1000
C164 1000
C159 1000
V104 6BJ6
C166 1000
V204 6AR8
C145 1000
C146 1000
C147 1000
C148 1000
V202 8106
C160 1000
C152 1000
V103 6EA8
L115 2.2µh
V301 6BJ6
C363 1000
V304 6CW4
C163 1000
C360 1000
R127 470
C361 1000
C262 1000
V203 8106
C263 1000
C161 1000
C150 1000
C149 1000
V102 6AK5
V302 6CB6
V303 6CB6
C260 1000
C261 1000
V201 7551
R129 270
C357 1000
C359 1000
C358 1000
C258 1000
C259 1000
L113 2.2µh
R234 150 3W
R128 47 2W
C151 1000
C167 1000
L112 2.2µh
CR105 8.2V ZENER
C162 1000
C331 (SEL)
Mixer V303 6CB6
C327 12
T302
C328 12
R314 15K 1/4W
R316 68, 1/4W
R333 15K, 1/4W
1st. I F Q302
R331 680, 1/4W
2nd. I F Q303
C321 .01mf
C334, 12
T303
DETECTOR CR301
CP301
10K
100K
1MEG
150K
180K
100
CR 303 NOISE LIM.
3000
470K
R337 10K, 1/4W
R335 10K 1/4W
C368 100
R336 68 1/4W
C326 .01mf
C325 .05mf
R309 680 1/4W
C329 .1mf
R342 220 1/4W
C330 .1mf
R332 2.2K 1/4W
C337 .1mf
C332 .1mf
R313 2.2K 1/4W
R312 470 1/4W
R334 150 1/4W
R317 470K
AGC DELAY CR302
C333 22mf
C335 .22mf
R315 6.8 MEG
C336 4700
C371 1000
R318 1MEG
R311 150
C241 1000
R324 2.2K
CP302
3.9 MEG
1MEG
.01mf
ICO
1000
R321 15K
AUDIO AMP V103-B 1/2 6EA8
C362 5uf
R341 150 Ω
R132 50K
R131 33K
R133 100K
IDENT FILTER
S313
R319 68K 1/4W
R323 680
C340 5100
C342 22mf
C339 .01mf
L317
EMITTER FOLLOWER Q304
R320 68K 1/4W
R339 2.2K 1/4W
R322 3.9K 1/4W
C143 1000
I102
No. 53 RED
R136 150 2W
14V. JUMPER
I101
No 53 RED
C169 1000

*See Figure 29 for test points and service data.

FIGURE 33. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B2

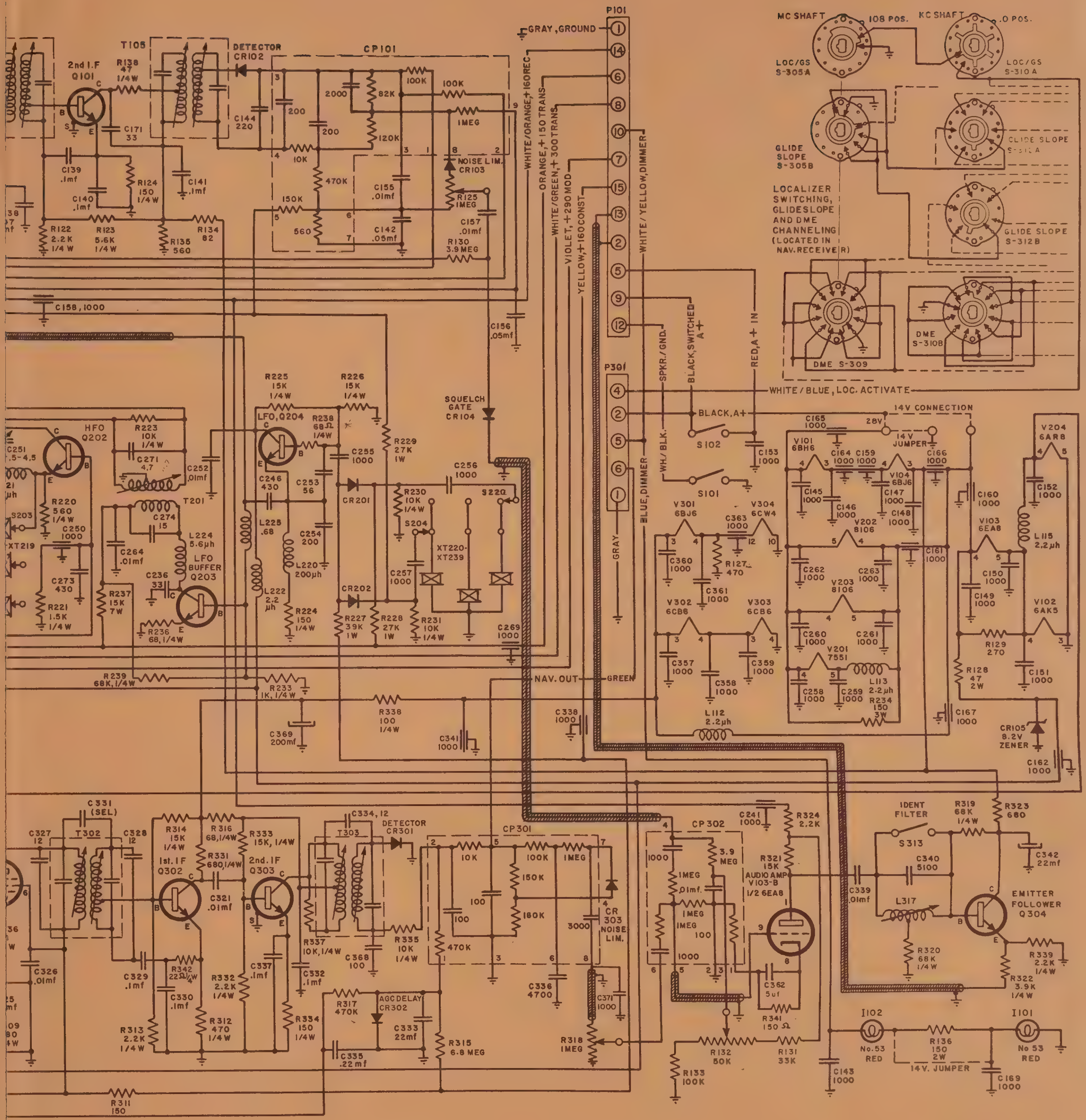

COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
J101
J301
P101
P301
RF AMP V101 6BH6
FIRST MIXER V102 6AK6
2nd MIXER V103-A 1/2 6EA8
1st I.F. V104 6BJ6
2nd I.F. Q101
DETECTOR CR102
CP101
+160 REC
FINAL V201 7551
FINAL DRIVER V202 6106
BUFFER V203 6106
BAL. MIXER V204 6AR8
HFO DOUBLER Q201
HFO Q202
LFO Q204
LFO BUFFER Q203
SQUELCH GATE CR104
RF AMP V301 6BJ6
HFO Q301
FIRST MIXER V302 6CB6
2nd MIXER V303 6CB6
LFO V304 6CW4
1st I.F. Q302
2nd I.F. Q303
DETECTOR CR301
CP301
AUDIO AMP V103-B 1/2 6EA8
EMITTER FOLLOWER Q304
8.2 V. REG
NAV. OUT
R239 68K, 1/4W
R233 1K 1/4W
GRAY, GROUND
WHITE/YELLOW, DIMMER
WHITE/BLUE, LOC. ACTIVATE
14V CONNECTION
14V JUMPER
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
MC SHAFT
KC SHAFT
GLIDE SLOPE
DME
ZENER
RED DOT ON CASE
B
E
C
S
Q101, Q201, Q202, Q301 Q303
Q203, Q204, Q302 Q304
TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

NOTES:

1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 5 7/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.

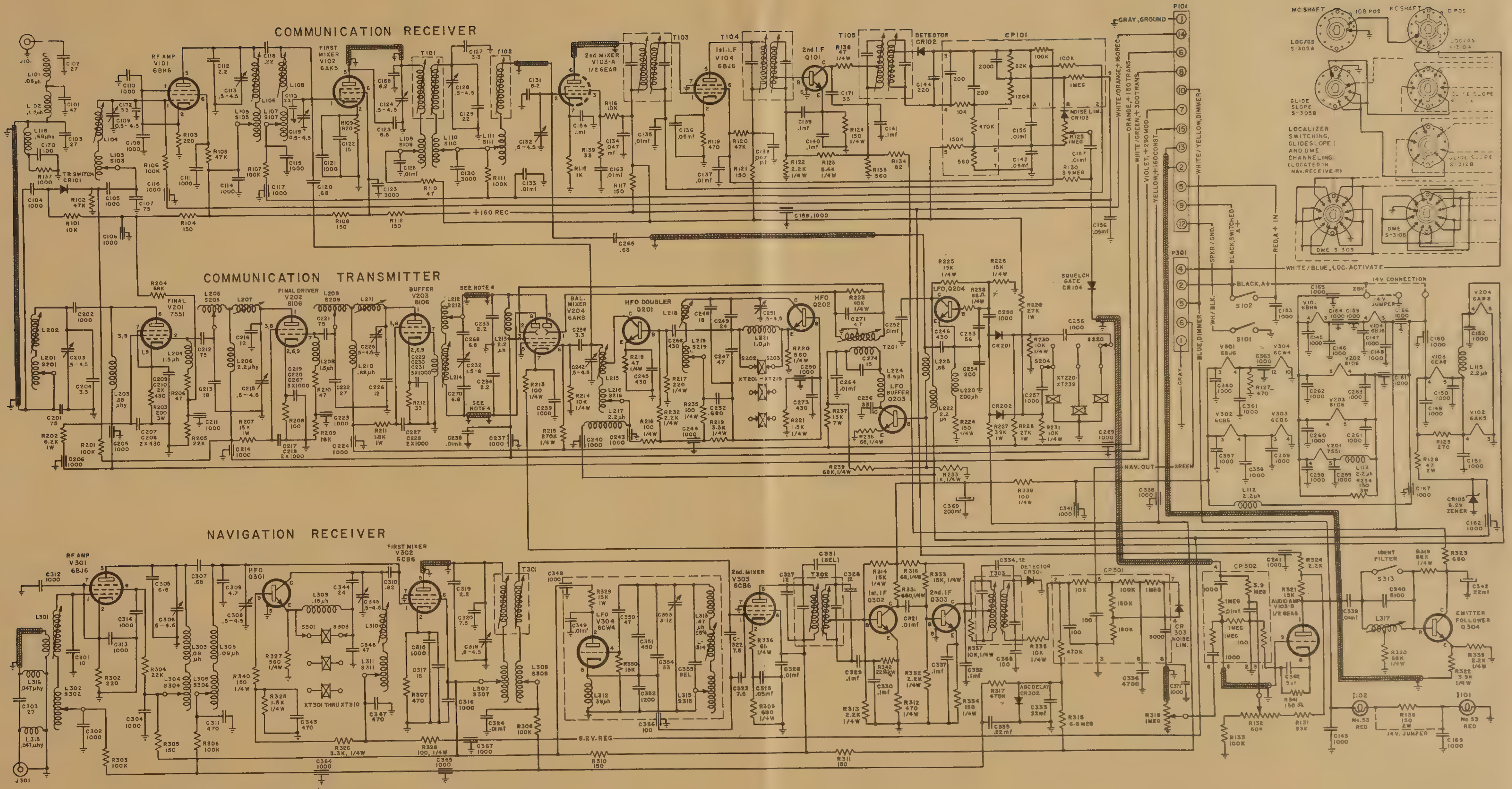
*See Figure 29 for test points and service data.

FIGURE 33. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B2


P101
GRAY, GROUND
WHITE/ORANGE,+160 REC.
ORANGE,+150 TRANS.
WHITE/GREEN,+300 TRANS.
VIOLET,+290 MOD.
YELLOW,+160 CONST.
WHITE/YELLOW, DIMMER
T105
2nd I.F Q101
R138 47 1/4W
DETECTOR CR102
CP101
C144 220
C171 33
C139 .1mf
C140 .1mf
R124 150 1/4W
C141 .1mf
R122 2.2K 1/4W
R123 5.6K 1/4W
R135 560
R134 82
100K
82K
120K
10K
470K
150K
560
2000
200
C155 .01mf
C142 .05mf
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9 MEG
C158, 1000
C156 .05mf
SQUELCH GATE CR104
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310 A
GLIDE SLOPE S-305B
GLIDE SLOPE S-310 A
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
GLIDE SLOPE S-312B
DME S-310B
DME S-309
SPKR./GND.
BLACK, SWITCHED A+
RED, A+ IN
P301
WHITE/BLUE, LOC. ACTIVATE
BLACK, A+
14V CONNECTION
S102
S101
WH./BLK.
BLUE, DIMMER
GRAY
C153 1000
C165 1000
28V
14V JUMPER
V101 6BH6
C164 1000
C159 1000
V104 6BJ6
C166 1000
C145 1000
C146 1000
C147 1000
C148 1000
V202 8106
C160 1000
V204 6AR8
C152 1000
V103 6EA8
L115 2.2µh
V301 6BJ6
V304 6CW4
C363 1000
C360 1000
R127 470
C361 1000
C262 1000
V203 8106
C263 1000
C161 1000
C150 1000
C149 1000
V102 6AK5
V302 6CB6
V303 6CB6
C260 1000
C261 1000
V201 7551
R129 270
C357 1000
C359 1000
C358 1000
C258 1000
C259 1000
L113 2.2µh
R234 150 3W
R128 47 2W
C151 1000
L112 2.2µh
C167 1000
CR105 8.2V ZENER
C162 1000
HFO Q202
R223 10K 1/4W
C271 4.7
C251 .5-4.5
R220 560 1/4W
S203
C250 1000
XT219
C273 430
R221 1.5K 1/4W
C252 .01mf
T201
C274 15
L224 5.6µh
C264 .01mf
LFO BUFFER Q203
C236 33
R237 15K 7W
R236 68, 1/4W
R225 15K 1/4W
R226 15K 1/4W
LFO, Q204
R238 68Ω 1/4W
C255 1000
R229 27K 1W
C246 430
C253 56
CR201
C256 1000
R230 10K 1/4W
S204
S22Ω
XT220-XT239
L225 .68
C254 200
L220 200µh
C257 1000
L222 2.2 µh
R224 150 1/4W
CR202
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
R239 68K, 1/4W
R233 1K, 1/4W
NAV. OUT
GREEN
R338 100 1/4W
C369 200mf
C341 1000
C338 1000
C331 (SEL)
C327 12
T302
C328 12
R314 15K 1/4W
R316 68, 1/4W
R333 15K, 1/4W
C334, 12
T303
DETECTOR CR301
CP301
1st. IF Q302
R331 680, 1/4W
2nd. IF Q303
C321 .01mf
10K
100K
1MEG
150K
180K
100
3000
CR 303 NOISE LIM.
R337 10K, 1/4W
C368 100
R335 10K 1/4W
470K
C336 4700
C371 1000
C326 .01mf
C329 .1mf
R342 22Ω 1/4W
C330 .1mf
R332 2.2K 1/4W
C337 .1mf
C332 .1mf
R317 470K
AGC DELAY CR302
C333 22mf
C335 .22 mf
R315 6.8 MEG
R313 2.2K 1/4W
R312 470 1/4W
R334 150 1/4W
R318 1MEG
R311 150
C241 1000
R324 2.2K
CP302
3.9 MEG
R321 15K
AUDIO AMP V103-B 1/2 6EA8
1MEG
.01mf.
1000
C362 5uf
R341 150 Ω
R132 50K
R131 33K
R133 100K
IDENT FILTER
R319 68K 1/4W
R323 680
S313
C340 5100
C342 22mf
C339 .01mf
L317
EMITTER FOLLOWER Q304
R320 68K 1/4W
R339 2.2K 1/4W
R322 3.9K 1/4W
I102
No.53 RED
R136 150 2W
14V. JUMPER
I101
No 53 RED
C143 1000
C169 1000

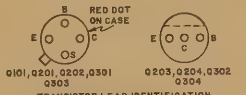
*See Figure 29 for test points and service data.

FIGURE 34. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B3


COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
RF AMP V101 6BH6
FIRST MIXER V102 6AK5
2nd MIXER V103-A 1/2 6EA8
1st. I.F V104 6BJ6
2nd I.F Q101
DETECTOR CR102
CP101
FINAL V201 7551
FINAL DRIVER V202 8106
BUFFER V203 8106
BAL. MIXER V204 6AR8
HFO DOUBLER Q201
HFO Q202
LFO Q204
LFO BUFFER Q203
SQUELCH GATE CR104
RF AMP V301 6BJ6
HFO Q301
FIRST MIXER V302 6CB6
LFO V304 6CW4
2nd. MIXER V303 6CB6
1st. IF Q302
2nd. IF Q303
DETECTOR CR301
CP301
CP302
AUDIO AMP V103-B 1/2 6EA8
EMITTER FOLLOWER Q304
IDENT FILTER
P101
P301
J101
J301
J102
J101
+160 REC
8.2 V. REG
NAV. OUT
GRAY, GROUND
WHITE/YELLOW/DIMMER
WHITE/BLUE, LOC. ACTIVATE
14V CONNECTION
14V. JUMPER
MC SHAFT
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-303

NOTES:

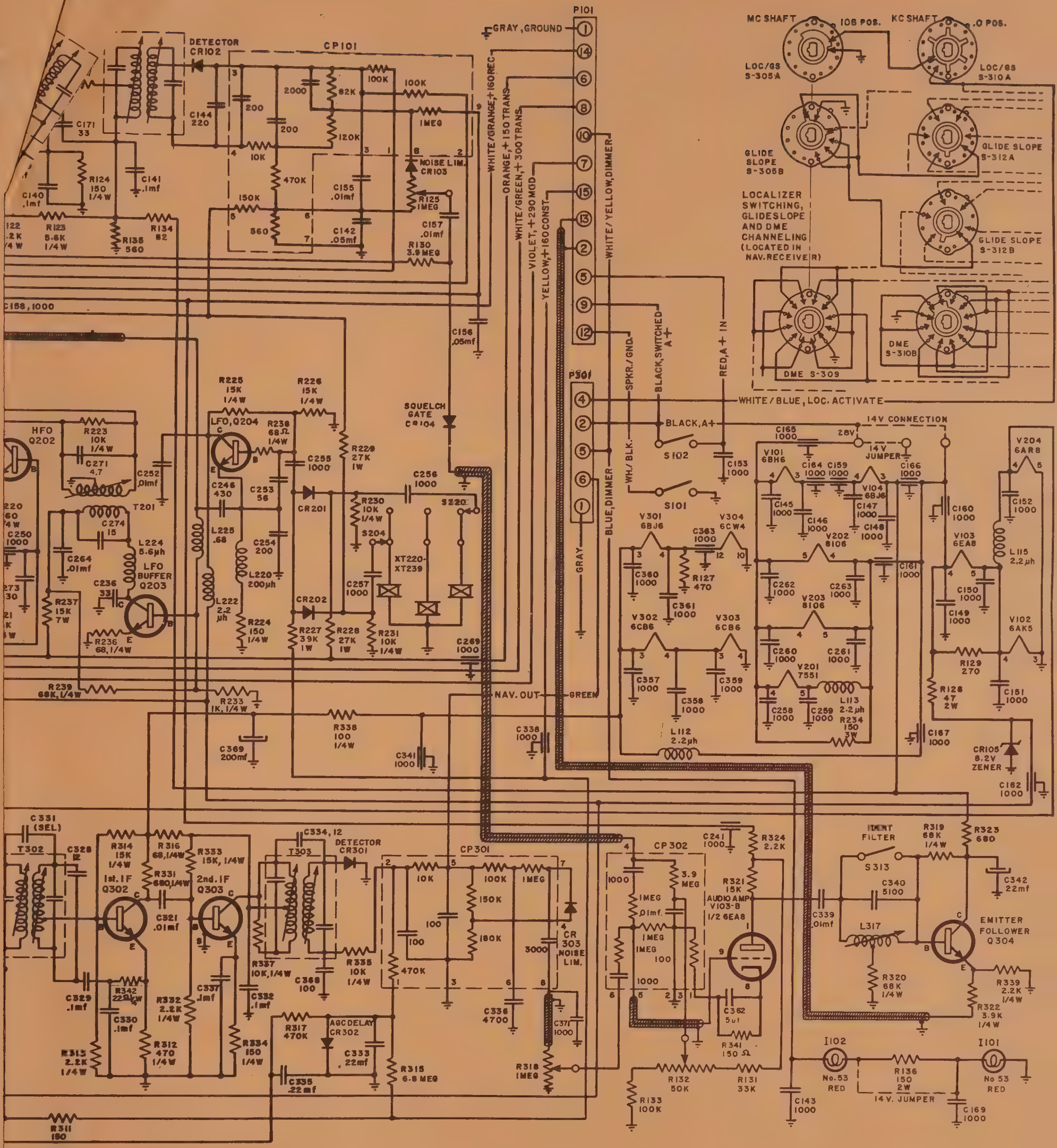
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 57/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.


B
RED DOT ON CASE
E
C
S
E
B
C
Q101, Q201, Q202, Q301 Q303
Q203, Q204, Q302 Q304

TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

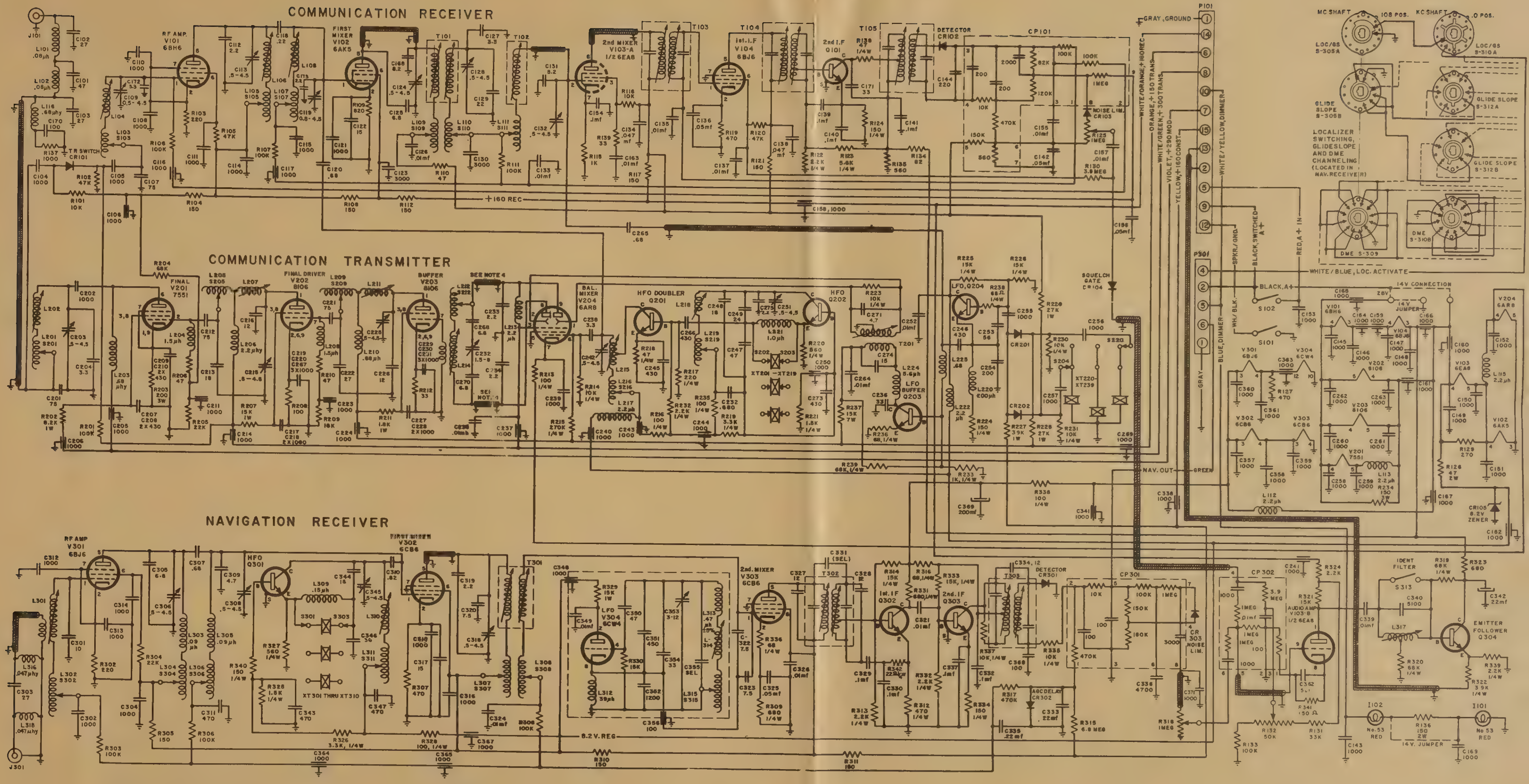
*See Figure 29 for test points and service data.

FIGURE 34. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B3


P101
GRAY, GROUND
DETECTOR CR102
CP101
C144 220
C171 33
C141 .1mf
C140 .1mf
R124 150 1/4W
R123 5.6K 1/4W
R122 .2K /4W
R134 82
R138 560
200
2000
82K
100K
100K
1MEG
120K
10K
470K
150K
560
C155 .01mf
C142 .05mf
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9 MEG
WHITE/ORANGE,+160REC.
ORANGE,+150 TRANS.
WHITE/GREEN,+300 TRANS.
VIOLET,+290 MOD.
YELLOW,+160 CONST.
WHITE/YELLOW, DIMMER
BLUE, DIMMER
GRAY
C158, 1000
C156 .05mf
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
GLIDE SLOPE S-312B
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-309
DME S-310B
SPKR./GND.
BLACK, SWITCHED A+
RED, A+ IN
WHITE/BLUE, LOC. ACTIVATE
P301
BLACK, A+
WH./BLK.
S102
S101
14V CONNECTION
28V
14 V JUMPER
C165 1000
C153 1000
V101 6BH6
C164 1000
C159 1000
V104 6BJ6
C166 1000
C145 1000
C146 1000
C147 1000
C148 1000
V202 8106
V204 6AR8
C152 1000
C160 1000
V103 6EA8
L115 2.2µh
V301 6BJ6
V304 6CW4
C363 1000
C360 1000
R127 470
C361 1000
C262 1000
V203 8106
C263 1000
C161 1000
C150 1000
C149 1000
V102 6AK5
V302 6CB6
V303 6CB6
C260 1000
C261 1000
V201 7551
R129 270
R128 47 2W
C151 1000
C357 1000
C358 1000
C359 1000
C258 1000
C259 1000
L113 2.2µh
R234 150 3W
C167 1000
L112 2.2µh
CR105 8.2V ZENER
C162 1000
HFO Q202
R223 10K 1/4W
C271 4.7
C252 .01mf
T201
C274 15
L224 5.6µh
C264 .01mf
C250 1000
LFO BUFFER Q203
C236 33
R237 15K 7W
R236 68, 1/4W
R225 15K 1/4W
R226 15K 1/4W
LFO, Q204
R238 68Ω 1/4W
C255 1000
R229 27K 1W
C246 430
C253 56
L225 .68
C254 200
L220 200µh
L222 2.2 µh
R224 150 1/4W
SQUELCH GATE CR104
C256 1000
CR201
R230 10K 1/4W
S220
S204
XT220-XT239
C257 1000
CR202
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
NAV. OUT
GREEN
R239 68K, 1/4W
R233 1K, 1/4W
C369 200mf
R338 100 1/4W
C341 1000
C338 1000
C331 (SEL)
T302
C328 2
R314 15K 1/4W
R316 68, 1/4W
R333 15K, 1/4W
R331 680, 1/4W
1st. IF Q302
2nd. IF Q303
C321 .01mf
C334, 12
T303
DETECTOR CR301
CP301
10K
100K
1MEG
150K
100
180K
3000
CR 303 NOISE LIM.
470K
R337 10K, 1/4W
C368 100
R335 10K 1/4W
C337 .1mf
C332 .1mf
C329 .1mf
R342 220 1/4W
C330 .1mf
R332 2.2K 1/4W
R313 2.2K 1/4W
R312 470 1/4W
R334 150 1/4W
R317 470K
AGC DELAY CR302
C333 22mf
C335 .22mf
R315 6.8 MEG
C336 4700
C371 1000
R318 1MEG
R311 180
CP302
C241 1000
R324 2.2K
1000
3.9 MEG
1MEG
.01mf.
1MEG
1MEG
100
1000
R321 15K
AUDIO AMP V103-B 1/2 6EA8
C362 5uf
R341 150 Ω
R132 50K
R131 33K
R133 100K
C143 1000
C339 .01mf
IDENT FILTER
S313
R319 68K 1/4W
R323 680
C342 22mf
C340 5100
L317
R320 68K 1/4W
EMITTER FOLLOWER Q304
R339 2.2K 1/4W
R322 3.9K 1/4W
I102
No.53 RED
R136 150 2W
14 V. JUMPER
I101
No 53 RED
C169 1000

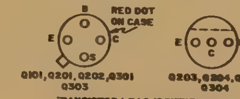
*See Figure 29 for test points and service data.

FIGURE 35. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B4


COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
RF AMP. V101 6BH6
FIRST MIXER V102 6AK5
2nd MIXER V103-A 1/2 6EA8
1st. I.F V104 6BJ6
2nd I.F Q101
DETECTOR CR102
CP101
P101
FINAL V201 7551
FINAL DRIVER V202 8106
BUFFER V203 8106
BAL. MIXER V204 6AR8
HFO DOUBLER Q201
HFO Q202
LFO Q204
LFO BUFFER Q203
SQUELCH GATE CR104
P301
RF AMP V301 6BJ6
HFO Q301
FIRST MIXER V302 6CB6
LFO V304 6CW4
2nd. MIXER V303 6CB6
1st. I.F Q302
2nd. I.F Q303
DETECTOR CR301
CP301
CP302
IDENT FILTER
EMITTER FOLLOWER Q304
MC SHAFT
KC SHAFT
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
GLIDE SLOPE
DME
14V CONNECTION
J101
J301

NOTES:

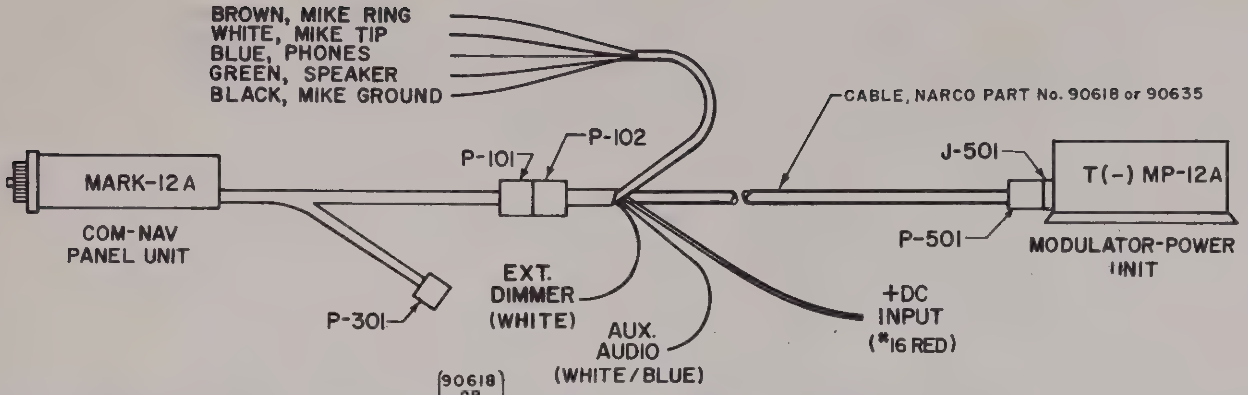
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 5 7/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.


B
RED DOT ON CASE
E
C
S
Q101, Q201, Q202, Q301 Q303
E
C
B
Q203, Q204, Q302 Q304

TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

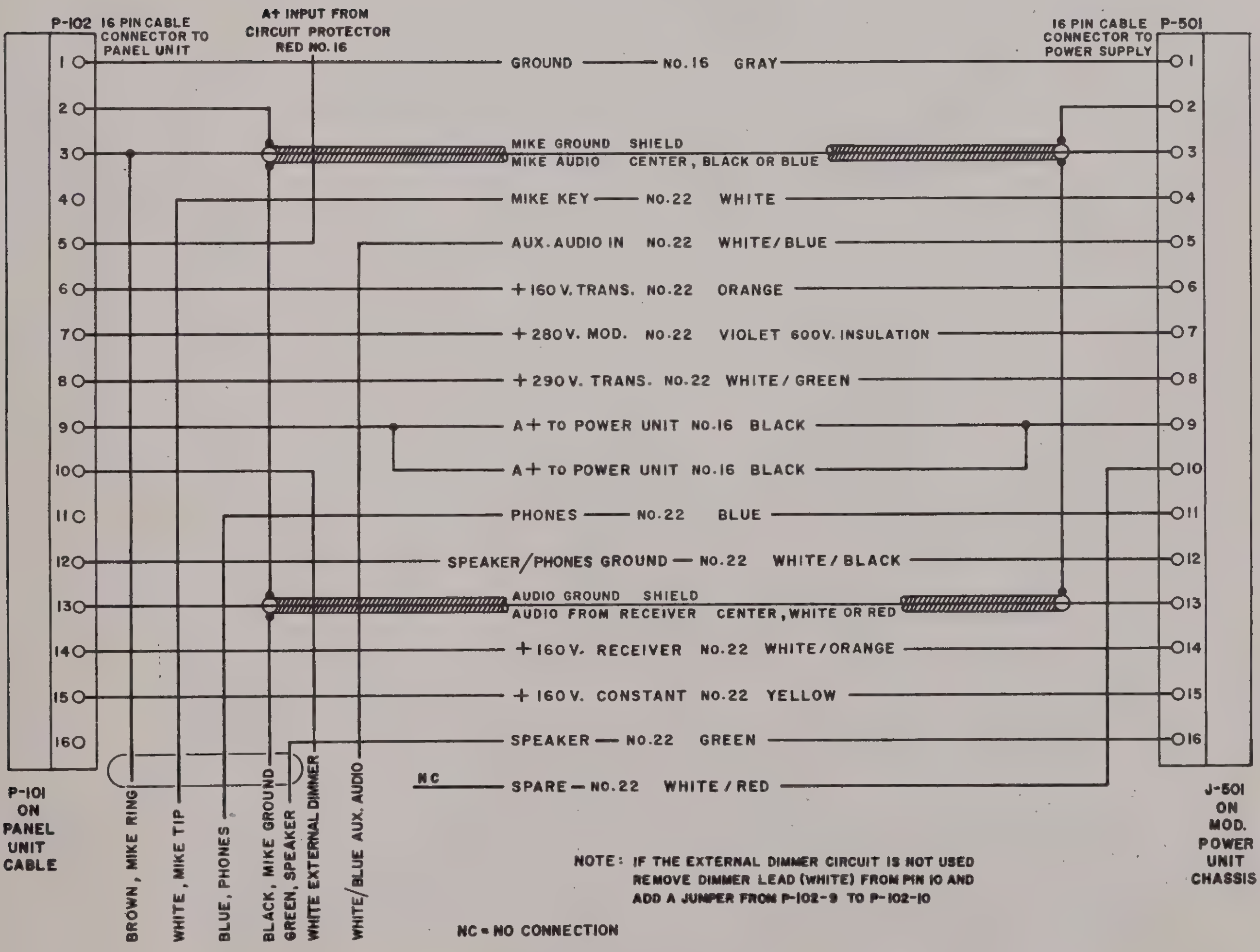
*See Figure 29 for test points and service data.

FIGURE 35. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B4


BROWN, MIKE RING
WHITE, MIKE TIP
BLUE, PHONES
GREEN, SPEAKER
BLACK, MIKE GROUND
CABLE, NARCO PART No. 90618 or 90635
P-102
P-101
J-501
MARK-12A
T(-) MP-12A
COM-NAV PANEL UNIT
P-501
MODULATOR-POWER UNIT
EXT. DIMMER (WHITE)
+DC INPUT (*16 RED)
P-301
AUX. AUDIO (WHITE/BLUE)

NOTE - CONNECTORS ON BOTH ENDS OF CABLE (90618 OR 90635) ARE ALIKE BUT EQUIPMENT WILL OPERATE ONLY WHEN CABLE IS INSTALLED AS SHOWN, WITH POWER AND ACCESSORY WIRES AT PANEL UNIT END.

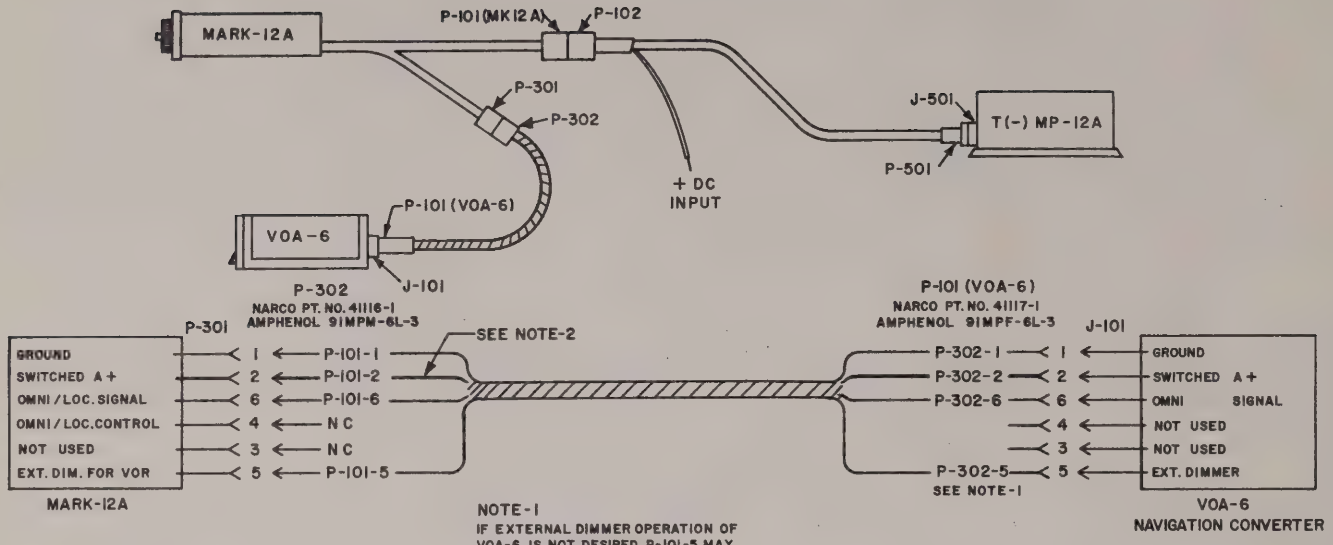
Figure 20.
narco Mark 12A Interconnecting Cable,
Power and Accessories.


P-102
16 PIN CABLE CONNECTOR TO PANEL UNIT
A+ INPUT FROM CIRCUIT PROTECTOR RED NO. 16
16 PIN CABLE CONNECTOR TO POWER SUPPLY
P-501
1 GROUND — NO. 16 GRAY 1
2 2
3 MIKE GROUND SHIELD 3
MIKE AUDIO CENTER, BLACK OR BLUE
4 MIKE KEY — NO. 22 WHITE 4
5 AUX. AUDIO IN NO. 22 WHITE/BLUE 5
6 +160 V. TRANS. NO. 22 ORANGE 6
7 +280 V. MOD. NO. 22 VIOLET 600V. INSULATION 7
8 +290 V. TRANS. NO. 22 WHITE/GREEN 8
9 A+ TO POWER UNIT NO. 16 BLACK 9
10 A+ TO POWER UNIT NO. 16 BLACK 10
11 PHONES — NO. 22 BLUE 11
12 SPEAKER/PHONES GROUND — NO. 22 WHITE/BLACK 12
13 AUDIO GROUND SHIELD 13
AUDIO FROM RECEIVER CENTER, WHITE OR RED
14 +160 V. RECEIVER NO. 22 WHITE/ORANGE 14
15 +160 V. CONSTANT NO. 22 YELLOW 15
16 SPEAKER — NO. 22 GREEN 16
NC SPARE — NO. 22 WHITE/RED
P-101 ON PANEL UNIT CABLE
BROWN, MIKE RING
WHITE, MIKE TIP
BLUE, PHONES
BLACK, MIKE GROUND
GREEN, SPEAKER
WHITE EXTERNAL DIMMER
WHITE/BLUE AUX. AUDIO
J-501 ON MOD. POWER UNIT CHASSIS

NOTE: IF THE EXTERNAL DIMMER CIRCUIT IS NOT USED REMOVE DIMMER LEAD (WHITE) FROM PIN 10 AND ADD A JUMPER FROM P-102-9 TO P-102-10

NC = NO CONNECTION

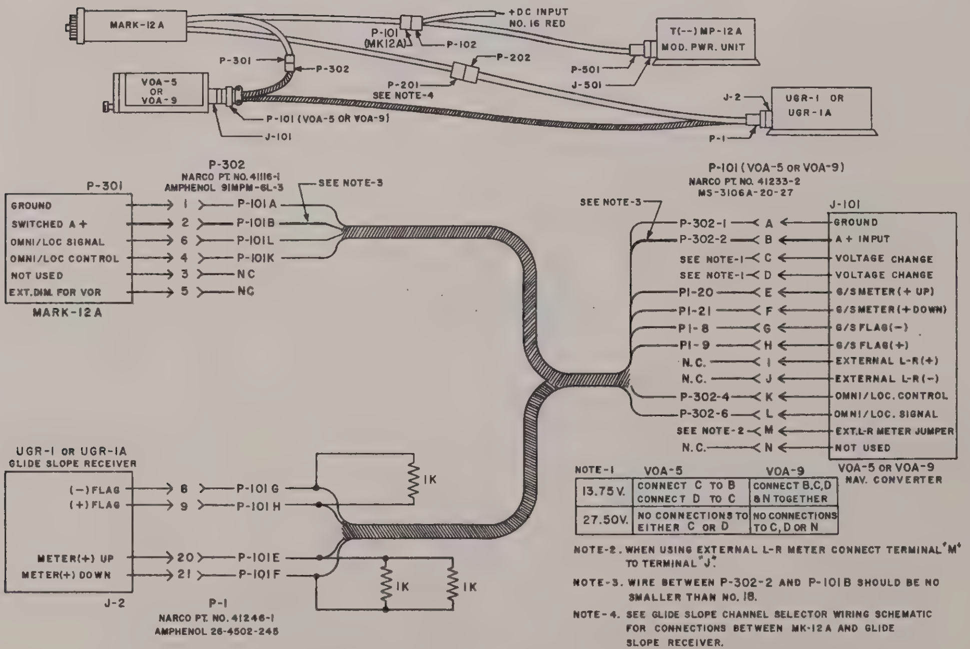
Figure 21.
narco Mark 12A CABLE CONNECTIONS,
Power and Accessories.


MARK-12A
P-101(MK12A)
P-102
P-301
P-302
J-501
T(-) MP-12A
P-501
+ DC
INPUT
P-101 (VOA-6)
VOA-6
J-101
P-302
NARCO PT. NO. 41116-1
AMPHENOL 91MPM-6L-3
P-301
SEE NOTE-2
GROUND
SWITCHED A +
OMNI/LOC. SIGNAL
OMNI/LOC. CONTROL
NOT USED
EXT. DIM. FOR VOR
1
2
6
4
3
5
P-101-1
P-101-2
P-101-6
N C
N C
P-101-5
MARK-12A
P-101 (VOA-6)
NARCO PT. NO. 41117-1
AMPHENOL 91MPF-6L-3
J-101
P-302-1
P-302-2
P-302-6
P-302-5
SEE NOTE-1
1
2
6
4
3
5
GROUND
SWITCHED A +
OMNI SIGNAL
NOT USED
NOT USED
EXT. DIMMER
VOA-6
NAVIGATION CONVERTER

NOTE-1
IF EXTERNAL DIMMER OPERATION OF VOA-6 IS NOT DESIRED, P-101-5 MAY BE CONNECTED TO P-101-2.

NOTE-2
WIRE BETWEEN P-302-2 & P-101-2 SHOULD BE NO SMALLER THAN NO. 18.

Figure 22.
INTERCONNECTIONS.
narco Mark 12A COM/NAV EQUIPMENT with
narco VOA-4 NAV CONVERTER.


MARK-12A
+DC INPUT
NO. 16 RED
T(--) MP-12A
MOD. PWR. UNIT
P-101
(MK12A)
P-102
P-202
P-301
P-302
P-501
J-501
VOA-5
OR
VOA-9
P-201
SEE NOTE-4
J-2
UGR-1 OR
UGR-1A
P-101 (VOA-5 OR VOA-9)
J-101
P-1
P-302
NARCO PT. NO. 41116-1
AMPHENOL 91MPM-6L-3
SEE NOTE-3
P-301
GROUND
SWITCHED A +
OMNI/LOC SIGNAL
OMNI/LOC CONTROL
NOT USED
EXT. DIM. FOR VOR
1
2
6
4
3
5
P-101 A
P-101B
P-101L
P-101K
NC
NC
MARK-12 A
P-101 (VOA-5 OR VOA-9)
NARCO PT. NO. 41233-2
MS-3106A-20-27
SEE NOTE-3
J-101
P-302-1
P-302-2
SEE NOTE-1
SEE NOTE-1
P1-20
P1-21
P1-8
P1-9
N.C.
N.C.
P-302-4
P-302-6
SEE NOTE-2
N.C.
A
B
C
D
E
F
G
H
I
J
K
L
M
N
GROUND
A + INPUT
VOLTAGE CHANGE
VOLTAGE CHANGE
G/S METER (+ UP)
G/S METER (+ DOWN)
G/S FLAG (−)
G/S FLAG (+)
EXTERNAL L-R (+)
EXTERNAL L-R (−)
OMNI/LOC. CONTROL
OMNI/LOC. SIGNAL
EXT. L-R METER JUMPER
NOT USED
VOA-5 OR VOA-9
NAV. CONVERTER
UGR-1 OR UGR-1A
GLIDE SLOPE RECEIVER
(−) FLAG
(+) FLAG
METER(+) UP
METER(+) DOWN
8
9
20
21
P-101 G
P-101 H
P-101E
P-101F
1K
1K
1K
J-2
P-1
NARCO PT. NO. 41246-1
AMPHENOL 26-4502-245

NOTE-1	VOA-5	VOA-9
13.75 V.	CONNECT C TO B CONNECT D TO C	CONNECT B, C, D & N TOGETHER
27.50V.	NO CONNECTIONS TO EITHER C OR D	NO CONNECTIONS TO C, D OR N

NOTE-2. WHEN USING EXTERNAL L-R METER CONNECT TERMINAL "M" TO TERMINAL "J".

NOTE-3. WIRE BETWEEN P-302-2 AND P-101B SHOULD BE NO SMALLER THAN NO. 18.

NOTE-4. SEE GLIDE SLOPE CHANNEL SELECTOR WIRING SCHEMATIC FOR CONNECTIONS BETWEEN MK-12A AND GLIDE SLOPE RECEIVER.

Figure 23.
INTERCONNECTIONS
narco VOA-5 CONVERTER and *narco* UGR-1A GLIDE SLOPE RECEIVER.

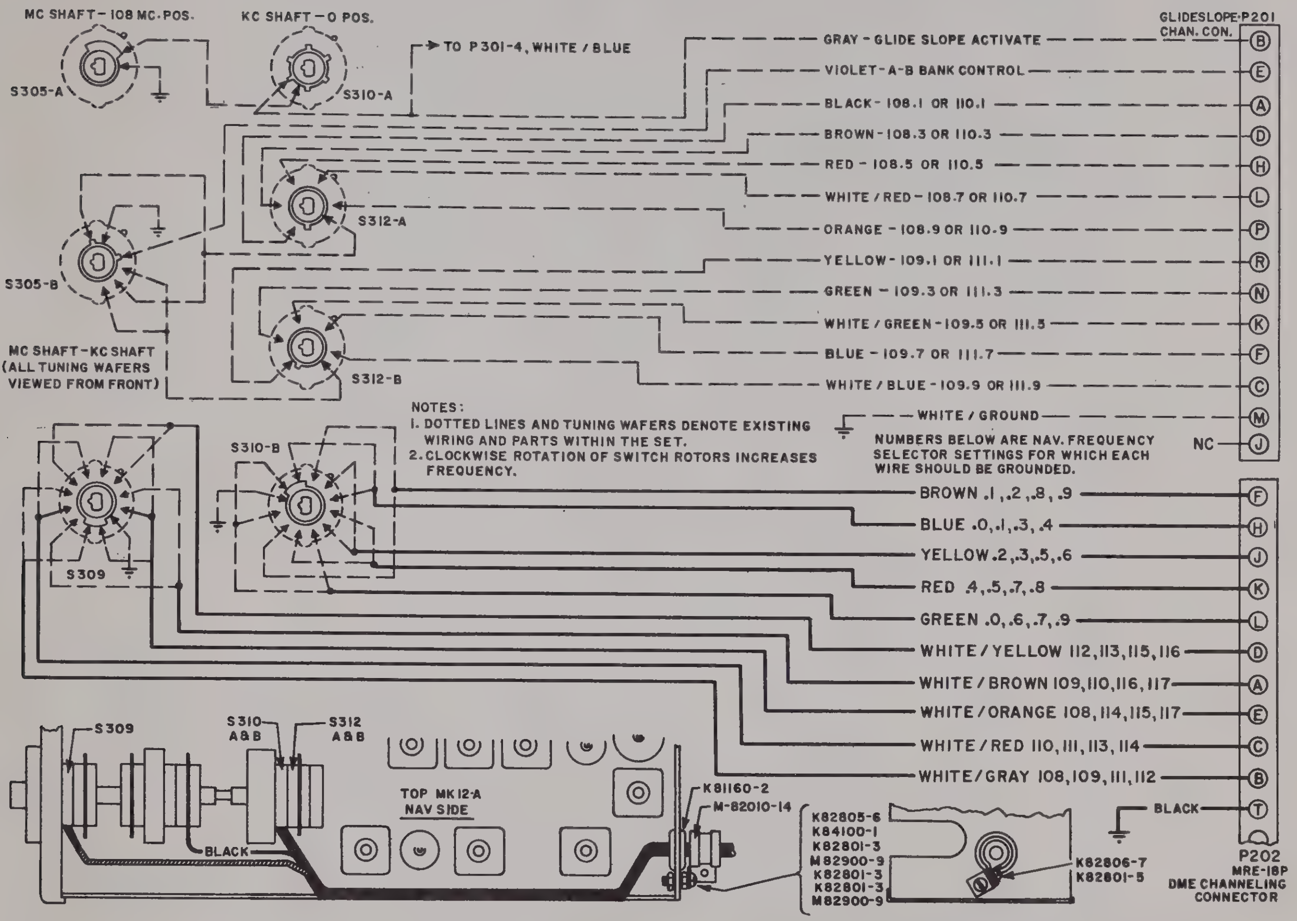

MC SHAFT – 108 MC. POS.
KC SHAFT – 0 POS.
S305-A
S310-A
TO P301-4, WHITE / BLUE
S312-A
S305-B
S312-B
MC SHAFT – KC SHAFT
(ALL TUNING WAFERS
VIEWED FROM FRONT)
GLIDESLOPE P201
CHAN. CON.
GRAY – GLIDE SLOPE ACTIVATE
VIOLET – A-B BANK CONTROL
BLACK – 108.1 OR 110.1
BROWN – 108.3 OR 110.3
RED – 108.5 OR 110.5
WHITE / RED – 108.7 OR 110.7
ORANGE – 108.9 OR 110.9
YELLOW – 109.1 OR 111.1
GREEN – 109.3 OR 111.3
WHITE / GREEN – 109.5 OR 111.5
BLUE – 109.7 OR 111.7
WHITE / BLUE – 109.9 OR 111.9
WHITE / GROUND
NC
B
E
A
D
H
L
P
R
N
K
F
C
M
J
NOTES:
1. DOTTED LINES AND TUNING WAFERS DENOTE EXISTING WIRING AND PARTS WITHIN THE SET.
2. CLOCKWISE ROTATION OF SWITCH ROTORS INCREASES FREQUENCY.
NUMBERS BELOW ARE NAV. FREQUENCY SELECTOR SETTINGS FOR WHICH EACH WIRE SHOULD BE GROUNDED.
S310-B
S309
BROWN .1, .2, .8, .9
BLUE .0, .1, .3, .4
YELLOW .2, .3, .5, .6
RED .4, .5, .7, .8
GREEN .0, .6, .7, .9
WHITE / YELLOW 112, 113, 115, 116
WHITE / BROWN 109, 110, 116, 117
WHITE / ORANGE 108, 114, 115, 117
WHITE / RED 110, 111, 113, 114
WHITE/GRAY 108, 109, 111, 112
BLACK
F
H
J
K
L
D
A
E
C
B
T
S309
S310 A & B
S312 A & B
BLACK
TOP MK12-A NAV SIDE
K81160-2
M-82010-14
K82805-6
K84100-1
K82801-3
M82900-9
K82801-3
K82801-3
M82900-9
K82806-7
K82801-5
P202
MRE-18P
DME CHANNELING
CONNECTOR

Figure 27.
SWITCH WIRING.
narco Mark 12A DME CHANNEL SELECTOR.

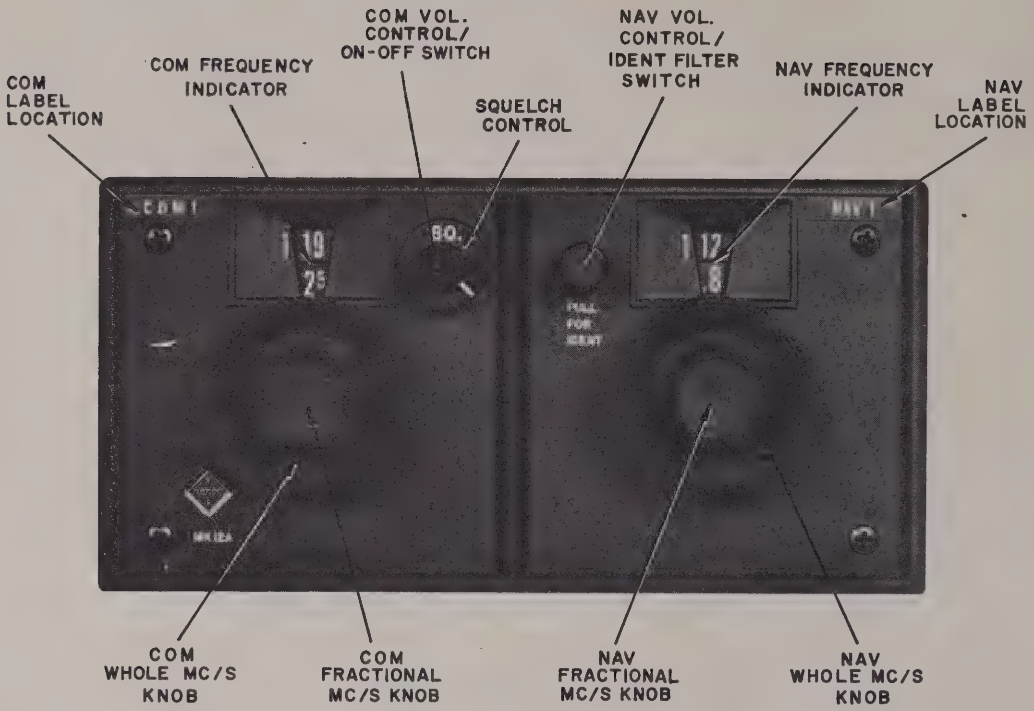

COM LABEL LOCATION
COM FREQUENCY INDICATOR
COM VOL. CONTROL/ ON-OFF SWITCH
SQUELCH CONTROL
NAV VOL. CONTROL/ IDENT FILTER SWITCH
NAV FREQUENCY INDICATOR
NAV LABEL LOCATION
COM 1
SQ.
NAV 1
PULL FOR IDENT
MK 12A
COM WHOLE MC/S KNOB
COM FRACTIONAL MC/S KNOB
NAV FRACTIONAL MC/S KNOB
NAV WHOLE MC/S KNOB

Photo A.
narco Mark 12A PANEL UNIT, Front View.

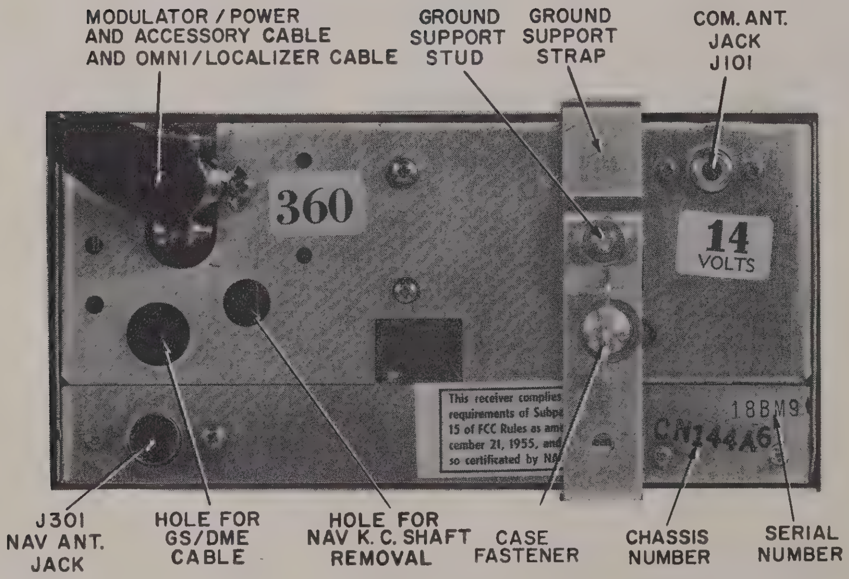

MODULATOR / POWER AND ACCESSORY CABLE AND OMNI / LOCALIZER CABLE
GROUND SUPPORT STUD
GROUND SUPPORT STRAP
COM. ANT. JACK J101
360
14 VOLTS
CN144A6
18BM9
J301 NAV ANT. JACK
HOLE FOR GS/DME CABLE
HOLE FOR NAV K.C. SHAFT REMOVAL
CASE FASTENER
CHASSIS NUMBER
SERIAL NUMBER

Photo B.
narco Mark 12A PANEL UNIT, Rear View, in Case.

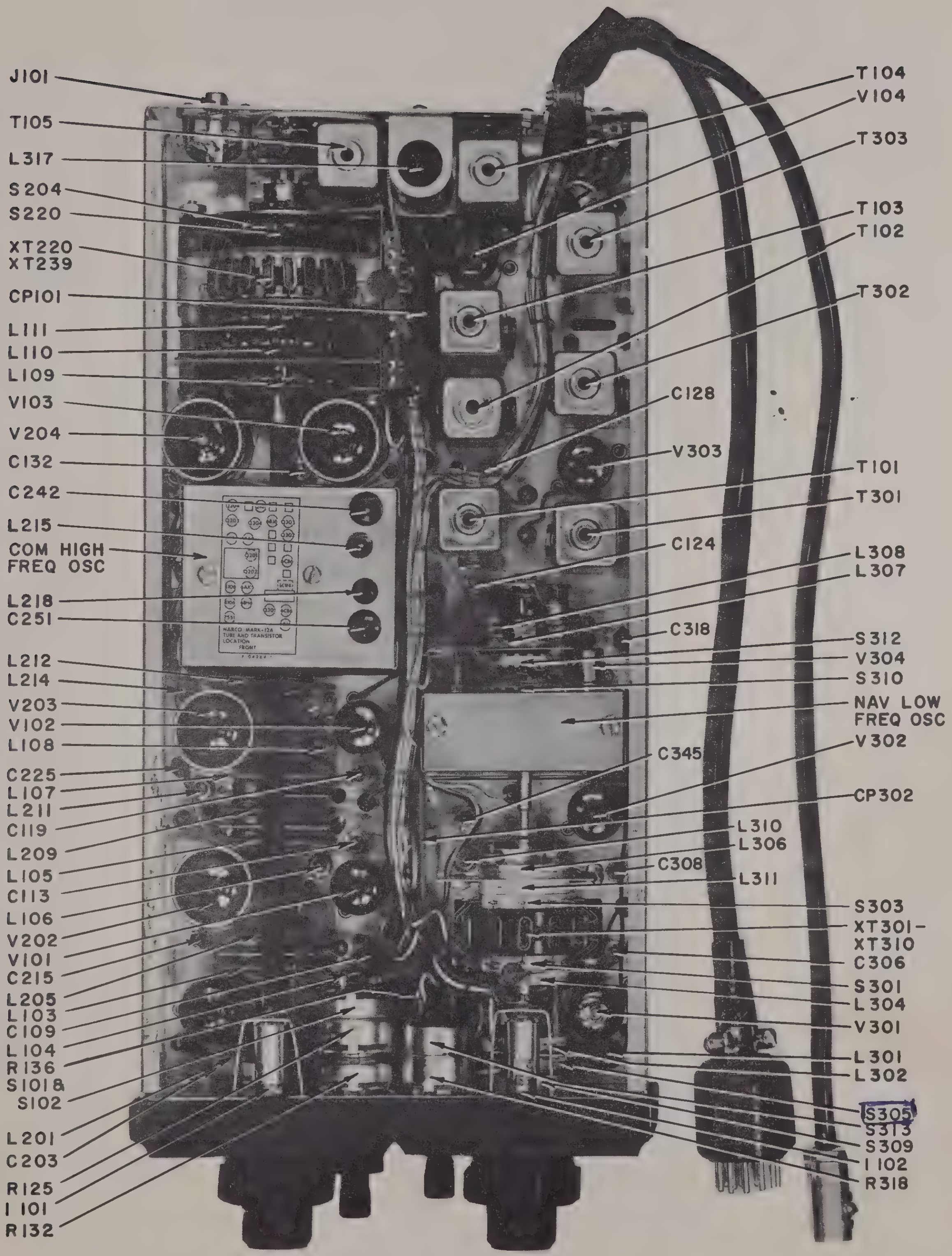

J101
T105
L317
S204
S220
XT220
XT239
CP101
L111
L110
L109
V103
V204
C132
C242
L215
COM HIGH
FREQ OSC
L218
C251
L212
L214
V203
V102
L108
C225
L107
L211
C119
L209
L105
C113
L106
V202
V101
C215
L205
L103
C109
L104
R136
S101&
S102
L201
C203
R125
I101
R132
T104
V104
T303
T103
T102
T302
C128
V303
T101
T301
C124
L308
L307
C318
S312
V304
S310
NAV LOW
FREQ OSC
V302
C345
CP302
L310
L306
C308
L311
S303
XT301-
XT310
C306
S301
L304
V301
L301
L302
S305
S313
S309
I102
R318
NARCO MARK-12A
TUBE AND TRANSISTOR
LOCATION
FRONT

Photo C.
narco Mark 12A PANEL UNIT, Top View.

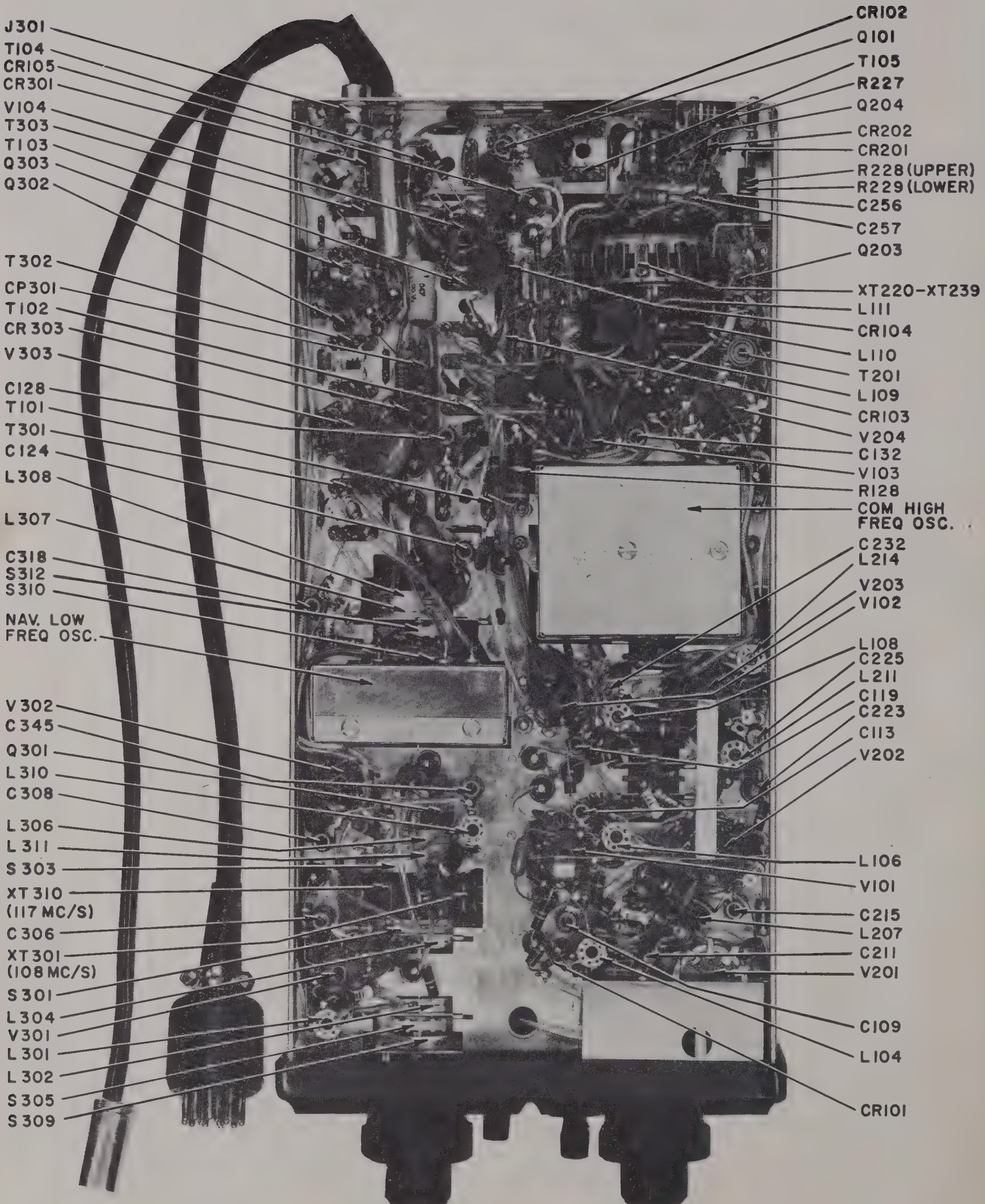

J301
T104
CR105
CR301
V104
T303
T103
Q303
Q302
T302
CP301
T102
CR303
V303
C128
T101
T301
C124
L308
L307
C318
S312
S310
NAV. LOW FREQ OSC.
V302
C345
Q301
L310
C308
L306
L311
S303
XT310 (117 MC/S)
C306
XT301 (108 MC/S)
S301
L304
V301
L301
L302
S305
S309
CR102
Q101
T105
R227
Q204
CR202
CR201
R228 (UPPER)
R229 (LOWER)
C256
C257
Q203
XT220-XT239
L111
CR104
L110
T201
L109
CR103
V204
C132
V103
R128
COM HIGH FREQ OSC.
C232
L214
V203
V102
L108
C225
L211
C119
C223
C113
V202
L106
V101
C215
L207
C211
V201
C109
L104
CR101

Photo D.
narco Mark 12A PANEL UNIT, Bottom View.

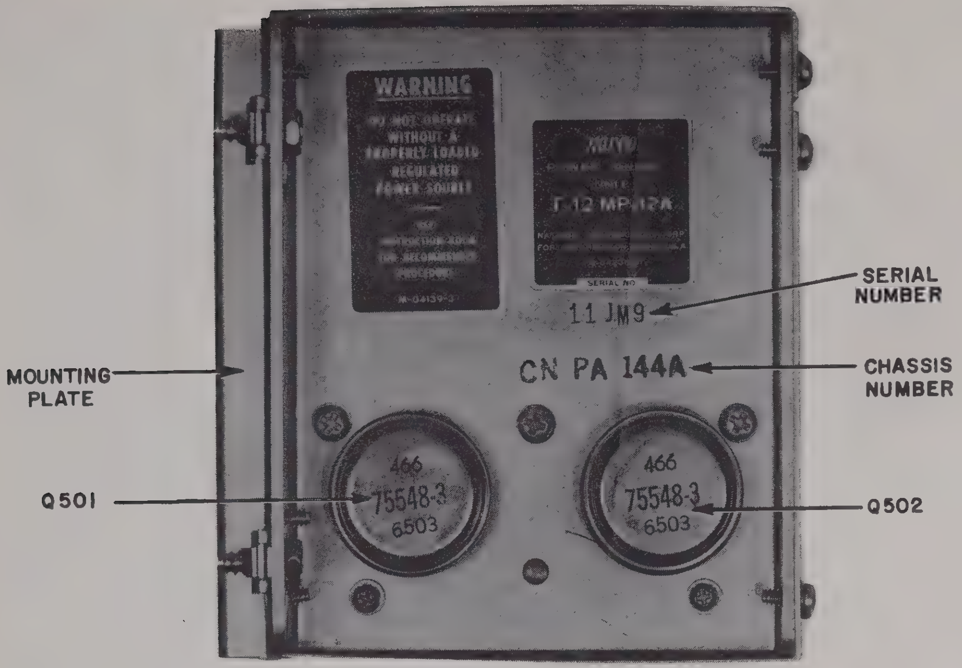

WARNING
SERIAL NO
11 JM9
SERIAL NUMBER
CN PA 144A
CHASSIS NUMBER
MOUNTING PLATE
466
75548-3
6503
Q501
Q502

Photo E.
narco Mark 12A MODULATOR-POWER UNIT, Front View.

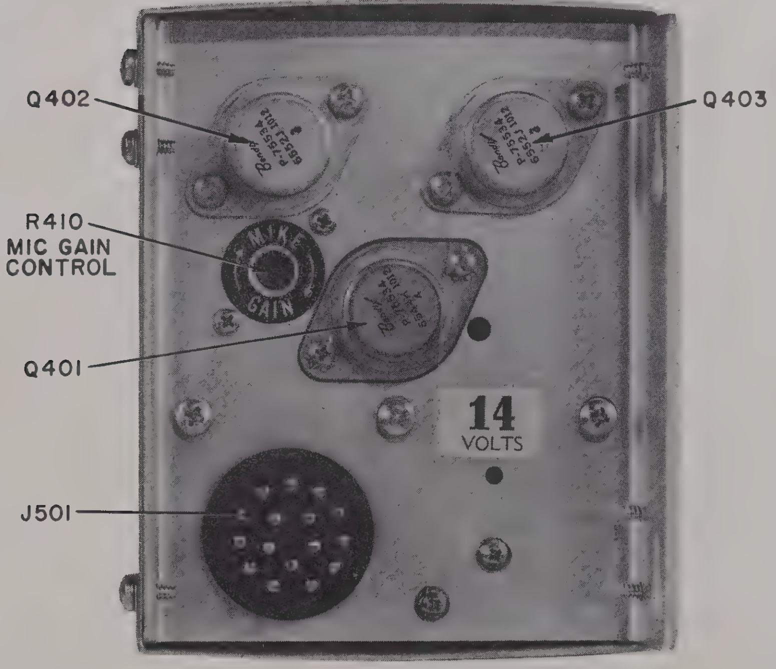

Q402
Q403
R410
MIC GAIN CONTROL
MIKE GAIN
Q401
14 VOLTS
J501

Photo F.
narco Mark 12A MODULATOR-POWER UNIT, Rear View.

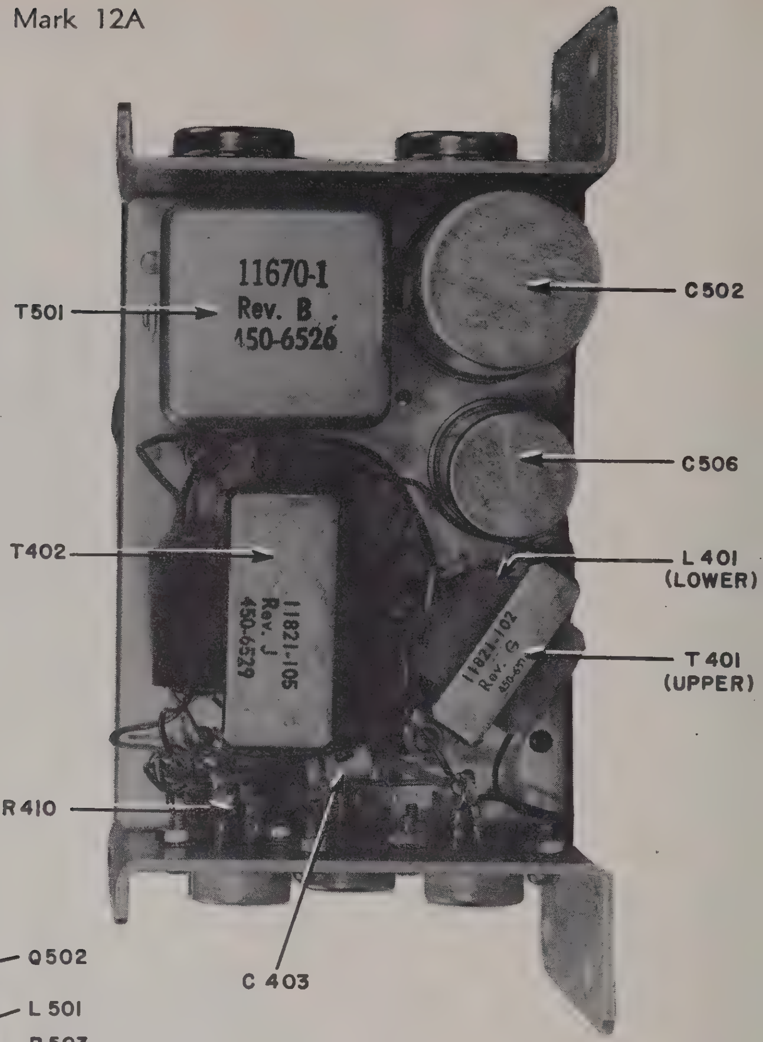

T501
11670-1
Rev. B
450-6526
C502
C506
T402
11821-105
Rev. J
450-6529
L 401
(LOWER)
11821-102
Rev. G
T 401
(UPPER)
R410
C 403

Photo G.
narco Mark 12A
MODULATOR-POWER UNIT,
Top View.

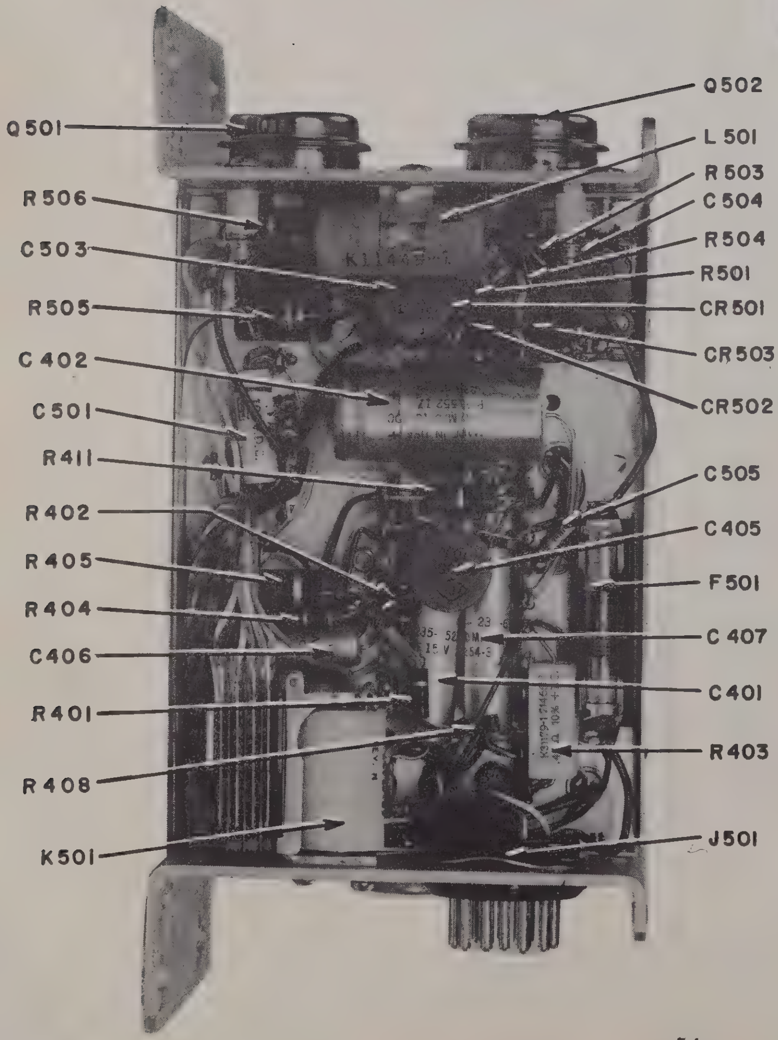

Q501
Q502
L 501
R506
R503
C504
C503
R504
R501
R505
CR501
CR503
C 402
CR502
C501
R411
C505
R402
C405
R405
F501
R404
C 407
C406
C401
R401
R403
R408
K501
J501

Photo H.
narco Mark 12A
MODULATOR-POWER UNIT,
Bottom View.

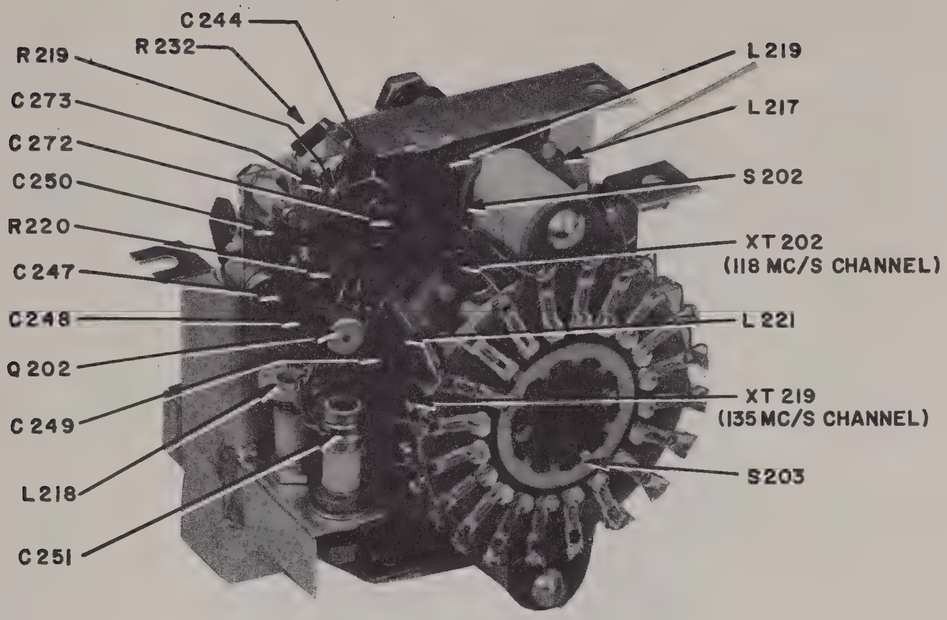

C 244
R 219
R 232
C 273
C 272
C 250
R220
C 247
C 248
Q 202
C 249
L 218
C 251
L 219
L 217
S 202
XT 202
(118 MC/S CHANNEL)
L 221
XT 219
(135 MC/S CHANNEL)
S203

Photo I.
COM HFO SUB-ASSEMBLY, Front View.

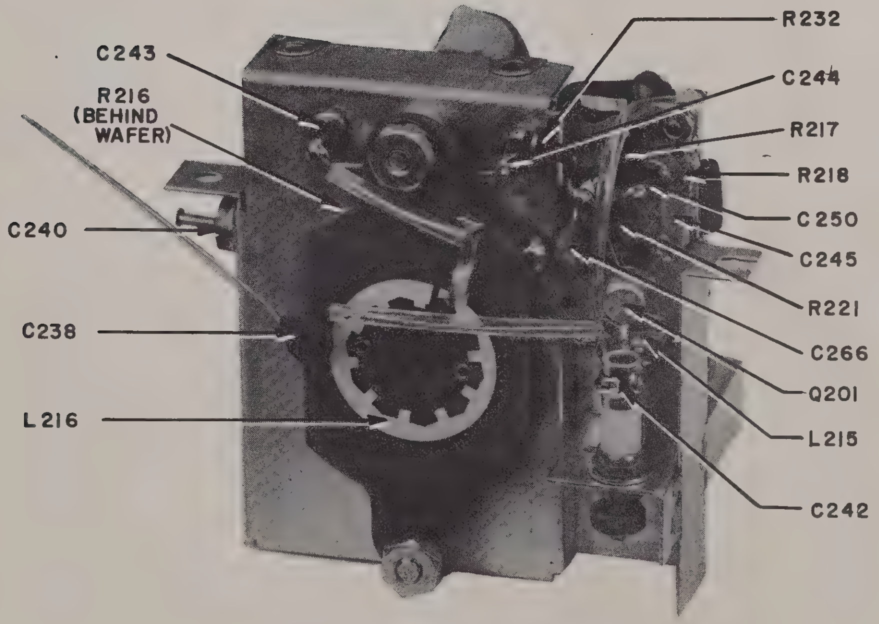

C243
R216
(BEHIND
WAFER)
C240
C238
L 216
R232
C 244
R217
R218
C 250
C245
R221
C266
Q201
L215
C242

Photo J.
COM HFO SUB-ASSEMBLY, Rear View.

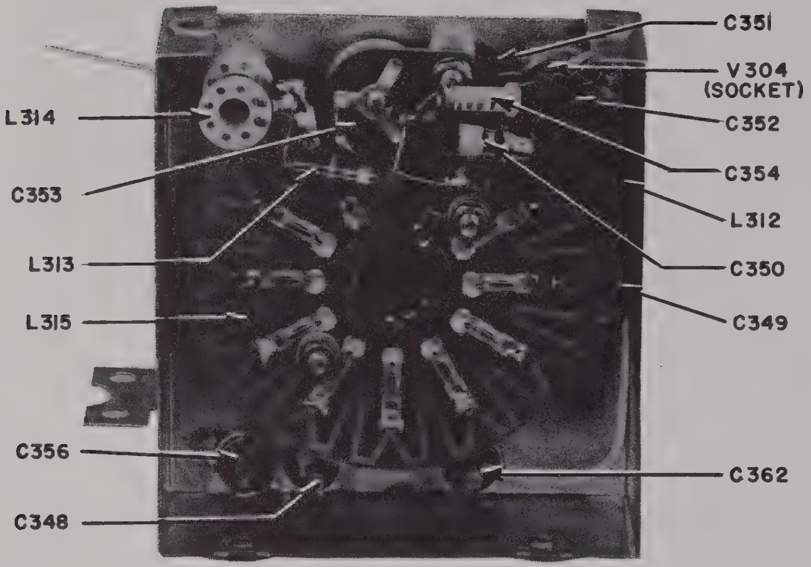

C351
V304
(SOCKET)
L314
C352
C354
C353
L312
L313
C350
L315
C349
C356
C362
C348

Photo K.
NAV LFO SUB-ASSEMBLY, Front View.

SECTION 7
REPLACEMENT PARTS

7-A. INTRODUCTION.

This list of Replacement Parts contains the items that may be considered replaceable in the field. They should preferably be ordered by Symbol No., Part No., and Description.

The Replacement Parts are listed by their Symbol letter and number, alphabetically then numerically. Some items without a Symbol No., are listed numerically by Part Number in a "Miscellaneous" List following the listings by Symbol numbers. A few items without a Symbol No. may be listed with associated parts such as connectors.

The "Function or Application" column is intended to separate the description of the item from its purpose in the equipment. It may also be found useful when working with the illustrations and Schematics.

7-B. LIST OF PARTS.

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS	
C-101	21201-470	Cap., Cer. Tub. 47 pf, ±10%, NPO, 500V	
C-102	21201-270	Cap., Cer. Tub. 27 pf, ±10%, NPO, 500V	
C-103	21201-270	Cap., Cer. Tub. 27 pf, ±10%, NPO, 500V	
C-104	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-105	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-106	21298-1	Cap., Feed Thru 1000 pf, +100%, —0%	
C-107	21384-750	Cap., Cer. Tub. 75 pf, ±5% N-750, 500V	
C-108	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-109	22019-2	Cap., Var. Plunger 1.5-12.5 pf	Com. Rcvr.
C-110	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-111	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-112	24516-229	Cap., Cer. Disc. 2.2 pf, ±.25 pf, 500V	
C-113	22019-1	Cap., Variable Plunger .5-4.5 pf	Com. Rcvr.
C-114	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-115	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-116	21298-1	Cap., Feed Thru 1000 pf, +100%, —0%	
C-117	21298-1	Cap., Feed Thru 1000 pf, +100%, —0%	Com. Rcvr.
C-118	24509-228	Cap., Cer. .22 pf, ±5%, 500V	
C-119	22019-2	Cap., Var. Plunger 1.5-12.5 pf	Com. Rcvr.
C-120	24502-688	Cap., Ceramic .68 pf, ±5%, 500V	
C-121	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-122	24516-150	Cap., Cer. Disc. 15 pf, ±10%, 500V	
C-123	21291-4	Cap., Cer. Disc., 3000 pf, +80%, —20%, 500V	
C-124	22019-1	Cap., Variable Plunger .5-4.5 pf	Com. Rcvr.
C-125	24516-689	Cap., Cer. Disc., 6.8 pf, ±0.5 pf, 500V	
C-126	21291-6	Cap., Cer. Disc., .01 μf, +80%, —30%, 500V	
C-127	24516-339	Cap., Cer. Disc., 3.3 pf, ±10%, 500V	
C-128	22019-1	Cap., Variable Plunger .5-4.5 pf	Com Rcvr.
C-129	21201-220	Cap., Cer. Tub., 22 pf, ±10%, NPO, 500V	
C-130	21291-9	Cap., Cer. Disc., 3000 pf, ±10%, 500V	
C-131	24516-829	Cap., Cer. Disc., 8.2 pf, ±0.5%, 500V	
C-132	22019-1	Cap., Variable Plunger .5-4.5 pf	Com. Rcvr.
C-133	21291-5	Cap., Ceramic, .01 mf, +80%, —20%, 50V	
C-134	23085-171	Cap., Mylar, .047 μf, ±10%, 20V	
C-135	21291-5	Cap., Ceramic, .01 μf, +80%, —20%, 50V	
C-136	24515-7	Cap., Ceramic, .05 μf, +80%, —20%, 20V	
C-137	21291-6	Cap., Ceramic Disc., .01 μf, +80%, —20%, 500V	
C-138	23085-171	Cap., Mylar, .047 μf, ±10%, 200V	
C-139	24515-1	Cap., Cer. Disc., .1 mf, +80%, —20%, 10V	
C-140	24515-1	Cap., Cer. Disc., .1 mf, +80%, —20%, 10V	
C-141	24515-6	Cap., Cer. Disc., .1 mf, +80%, —20%, 20V	
C-142	24515-7	Cap., Ceramic, .05 μf, +80%, —20%, 20V	
C-143	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-144	24049-221	Cap., Dipped Mica, 220 pf, ±5%, 500V	
C-145	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	

SYMBOL	NARO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS	
C-146	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-147	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-148	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-149	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-150	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-151	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-152	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-153	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-154	24515-1	Cap., Cer. Disc., .1 μf, +80%, —20%, 10V	
C-155	24515-9	Cap., Cer. Disc., .01 mf, +80%, —20%, 50V	
C-156	24515-7	Cap., Cer. Disc.,. 05 mf, +80%, —20%, 20V	
C-157	21291-6	Cap., Cer. Disc., .01 mf, +80%, —20%, 500V	
C-158	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-159	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-160	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-161	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-162	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-163	21291-6	Cap., Cer. Disc., .01 mf, +80%, —20%, 500V	
C-164	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-165	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-166	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-167	21298-1	Cap., Feedthru, 1000 pf, +100%, —0%	
C-168	24516-829	Cap., Cer. Disc., 8.2 pf, ±0.5 pf, 500V	
C-169	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-170	24049-101	Cap., Dipped Mica, 100 pf, ±5%, 500V	
C-171	24049-330	Cap. Dipped Mica, 33 pf, ±5%	
C-201	21384-750	Cap., Cer. Tub., 75 pf, ±5%, N-750, 500V	
C-202	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-203	22019-1	Cap., Variable Plunger, .5-4.5 pf	Com. Trans.
C-204	24516-339	Cap., Cer. Disc., 3.3 pf, ±.25 pf, 500V	
C-205	21298-1	Cap., Feed Thru 1000 pf, +100%, —0%	
C-206	21298-1	Cap., Feed Thru 1000 pf, +100%, —0%	
C-207	21291-1	Cap., Cer. Disc., 430 pf, ±20%, 500V	
C-208	21291-1	Cap., Cer. Disc., 430 pf, ±20%, 500V	
C-209	21291-1	Cap., Cer. Disc., 430 pf, ±20%, 500V	
C-210	21291-1	Cap., Cer. Disc., 430 pf, ±20%, 500V	
C-211	21298-1	Cap., Feed Thru 1000 pf, +100%, —0%	Com. Trans.
C-212	21384-750	Cap., Cer. Tub., 75 pf, ±5%, N-470, 500V	
C-213	21201-180	Cap., Cer. Tub., 18 pf, ±10%, NPO, 500V	
C-214	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	
C-215	22019-1	Cap., Variable Plunger, .5-4.5 pf	Com. Trans.
C-216	21201-120	Cap., Cer. Tub., 10 pf, ±10%, NPO, 500V	
C-217	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-218	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-219	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-220	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-221	21384-750	Cap., Cer. Tub., 75 pf, ±5%, N-470, 500V	
C-222	21201-270	Cap., Cer. Tub., 27 pf, ±10%, 500V, NPO	
C-223	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	
C-224	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	
C-225	22019-1	Cap., Variable Plunger, .5-4.5 pf	Com. Trans.
C-226	21201-120	Cap., Cer. Tub., 12 pf, ±10%, NPO, 500V	
C-227	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-228	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-229	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-230	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-231	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-232	22045-1	Cap., Var. Cer., 1.5-8 pf, NPO	
C-233	24516-229	Cap., Cer. Disc., 2.2 pf, ±.25 pf, 500V	Com. Trans.
C-234	24516-229	Cap., Cer. Disc., 2.2 pf, ±.25 pf, 500V	
C-235	21291-6	Cap., Cer. Disc., .01 μf, 500V GMV	
C-236	24049-330	Cap., Dipped Mica, 33 pf, ±5% 500V	
C-237	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	
C-238	24516-339	Cap., Cer. Disc., 3.3 pf, ±0.25 pf, 500V	Com. HFO
C-239	21291-21	Cap., Cer. Disc. 1000 pf, ±20%, 1KV	
C-240	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	Com. HFO

C, CAPACITORS

SYMBOL	NARO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
C-241	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	
C-242	22019-1	Cap., Variable Plunger, .5-4.5 pf	Com. HFO
C-243	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	Com. HFO
C-244	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	Com. HFO
C-245	21291-1	Cap., Cer. Disc., 430 pf, ±20%, 1KV	
C-246	21291-1	Cap., Cer. Disc., 430 pf, ±20%, 1KV	
C-247	24049-470	Cap., Dipped Mica, 47 pf, ±5%, 500V	Com. HFO
C-248	24049-180	Cap., Dipped Mica, 18 pf, ±5%, 500V	Com. HFO
C-249	24049-240	Cap., Dipped Mica, 24 pf, ±5%, 500V	Com. HFO
C-250	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	Com. HFO
C-251	22019-15	Cap., Variable Plunger, .5-4.5 pf	
C-252	24515-9	Cap., Cer. Disc., .01 µf, +80%, —20%, 50V	
C-253	24049-560	Cap., Dipped Mica, 56 pf, ±5%, 500V	
C-254	24049-201	Cap., Cer. Disc., 200 pf, ±10%, 300V	
C-255	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-256	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-257	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-258	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-259	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-260	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-261	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-262	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-263	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-264	24515-9	Cap., Cer. Disc., .01 µf, +80%, —20%, 50V	
C-265	24502-688	Cap., Ceramic, .68 pf, ±5%, 500V	
C-266	21291-1	Cap., Cer. Disc., 430 pf, ±20%, 500V	Comm. HFO
C-267	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-268	24516-689	Cap., Cer. Disc., 6.8 pf, ±0.5 pf, 500V	
C-269	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	
C-270	24516-689	Cap., Cer. Disc., 6.8 pf, ±0.5 pf, 500V	
C-271	24516-479	Cap., Cer. Disc., 4.7 pf, ±0.5 pf, 500V	
C-272	24045-681	Cap., Dipped Mica, 680 pf, ±5%, 500V	Comm. HFO
C-273	21291-1	Cap. Cer. Disc., 430 pf, ±20%, 500V	Comm. HFO
C-274	21201-150	Cap., Tub., Cer. 15 pf, ±10%, NPO	
C-301	21201-100	Cap., 10 pf, ±1.0 pf, NPO, 500V	
C-302	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-303	21201-270	Cap., Cer. Tub., 27 pf, ±100%, 500V	
C-304	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-305	24516-689	Cap., Cer. Disc., 6.8 pf, ±.5 pf, 500V	
C-306	22019-1	Cap., Variable Plunger, .5-4.5 pf	Nav. Rcvr.
C-307	24509-688	Cap., Cer., .68 pf, ±5%, 500V	
C-308	22019-1	Cap., Variable Plunger, .5-4.5 pf	Nav. Rcvr.
C-309	24516-479	Cap., Cer. Disc., 4.7 pf, ±0.5 pf, 500V	
C-310	24509-828	Cap., Cer., .82 pf, ±5%, 500V	Nav. Rcvr.
C-311	21291-2	Cap., Cer. Disc., 470 pf, ±10%, 500V	
C-312	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-313	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-314	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-315	21291-4	Cap., Cer. Disc., 3000 pf, +80%, —20%, 500V	
C-316	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-317	24516-150	Cap., Cer. Disc., 15 pf, ±10%, 500V	
C-318	22019-1	Cap., Variable Plunger, .5-4.5 pf	Nav. Rcvr.
C-319	21201-229	Cap., Cer. Tub., 2.2 pf, ±.25, 500V	
C-320	21282-2	Cap., Cer. Tub., 7.5 pf, ±0.5%, 500V, P-100	
C-321	24515-9	Cap., Cer. Disc., .01 µf, +80%, —20%, 50V	
C-322	21201-759	Cap., Cer. Tub., 7.5 pf, NPO	
C-323	21282-2	Cap., Cer. Tub., 7.5 pf, ±0.5%, 500V, P-100	
C-324	21291-6	Cap., Disc., Cer. .01 µf, GMV, 500V	
C-325	24515-7	Cap., Ceramic, .05 µf, +80%, —20%, 20V	
C-326	21291-6	Cap., Cer. Disc., .01 µf, +80%, —20%, 500V	
C-327	21207-120	Cap., Cer. Tub., 12 pf, N-750	
C-328	21207-120	Cap., Cer. Tub., 12 pf, N-750	
C-329	24515-1	Cap., Cer. Disc., .1 µf, +80%, —20%, 10V	
C-330	24515-1	Cap., Cer. Disc., .1 µf, +80%, —20%, 10V	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS	
C-331	24509	Cap., Cer., Selected	
C-332	24515-6	Cap., Cer. Disc., .1 μf, +80%, —20%, 20V	
C-333	23091-79	Cap., Ceramic, .22 μf, ±10%, 75V	
C-334	21207-120	Cap., Cer. Tub., 12 pf, M-750	
C-335	23091-79	Cap., Cer., .22 μf, ±10%, 75V	
C-336	23085-9	Cap., Mylar, 4700 pf, ±20%, 100V	
C-337	24515-1	Cap., Cer. Disc., .1 μf, +80%, —20%, 10V	
C-338	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	Nav. Rcvr.
C-339	21291-6	Cap., Cer. Disc., .01 μf, +80%, —20%, 500V	
C-340	24045-512	Cap., Dipped Mica, 5100 pf, ±5%, 300V	
C-341	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	
C-342	21555-18	Cap., Solid Tantalum, 22/15	
C-343	21291-2	Cap., Cer. Disc., 470 pf, ±20%, 500V	
C-344	24049-240	Cap., Dipped Mica, 24 pf, ±5%, 500V	
C-345	22019-1	Cap., Variable Plunger, .5-4.5 pf	Nav. Rcvr.
C-346	24049-470	Cap., Dipped Mica, 47 pf, ±5%, 500V	
C-347	21291-2	Cap., Cer. Disc., 470 pf, ±20%, 500V	
C-348	21298-1	Cap., Feed Thru, 1000 pf, +100%, —0%	Nav. LFO
C-349	21291-6	Cap., Cer. Disc., .01 μf, 500V, GMV	Nav. LFO
C-350	21299-470	Cap., Cer. Tub., 47 pf, NPO, 500V	Nav. LFO
C-351	24049-431	Cap., Dipped Mica, 430 pf, ±5%	Nav. LFO
C-352	24045-122	Cap., Dipped Mica, 1200 pf, ±5%	Nav. LFO
C-353	22001-312	Cap., Variable, 3-12 pf, NPO	Nav. LFO
C-354	21294-330	Cap., Cer. Tub., 33 pf, N-1500	
C-355	21201-470	Cap., Cer. Tub., Selected	
C-356	24517-1	Cap., Feed Thru, 100 pf.	Nav. Rcvr.
C-357	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-358	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-359	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-360	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-361	21291-21	Cap., Cer. Disc., 1000 pf, ±20%, 1KV	
C-362	21552-1	Cap., Electrolytic, 5.0μf, 10V	
C-363	21298-1	Cap., Feed Thru, 1000 pf, +80%, —20%	
C-364	21298-1	Cap., Feed Thru, 1000 pf, +80%, —20%	
C-365	21298-1	Cap., Feed Thru, 1000 pf, +80%, —20%	
C-366		Not Used	
C-367	21298-1	Cap., Feed Thru, 1000 pf, +80%, —20%	
C-368	24049-101	Cap., Dipped Mica, 100 pf, ±5%, 500V	
C-369	21554-3	Cap., Electrolytic, 200 μf, 15V	
C-370	24516-689	Cap., Cer. Disc., 6.8 pf, ±0.5 pf, 500V	
C-401	21554-3	Cap., Electrolytic 200/15	
C-402	21552-17	Cap., Electrolytic 500/15	
C-403	23085-113	Cap., Mylar, .01 ±20%, 200V	
C-404	21552-3	Cap., Electrolytic 20/35	
C-405	21291-22	Cap., Ceramic Disc., .005 mfd, ±10%, 500V	
C-406	21552-18	Cap., Electrolytic 30/15	
C-407	21554-3	Cap., Electrolytic 200/15	
C-501	23085-25	Cap., Mylar, .1 mfd, 20%, 100V	
C-502	21556-1	Cap., Electrolytic, 40/475, 20/250, 100/250	
C-503	21291-22	Cap., Ceramic Disc., .005 mfd, ±10%, 500V	Mod. Pwr. 14V
C-503	21291-23	Cap., Ceramic Disc., .004 mfd, ±10%, 500V	Mod. Pwr. 28V
C-504	21291-22	Cap., Ceramic Disc., .005 mfd, ±10%, 500V	Mod. Pwr. 14V
C-504	21291-23	Cap., Ceramic Disc., .004 mfd, ±10%, 500V	Mod. Pwr. 28V
C-505	21555-48	Cap., Solid Tant., 1.0 mfd, 35V	
C-506	21525-29	Cap., Electrolytic 500/35	
C-507	23085-25	Cap., Mylar, .1 mfd, 20%, 100V	
C-508	23085-25	Cap., Mylar, .1 mfd, 20%, 100V	
		CP, CIRCUIT PLATES	
CP-101	24525-1	Circuit Plate Comm. Detector	
CP-301	24524-1	Circuit Nav. Detector	
CP-302	24526-1	Circuit Plate Audio Combiner	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		CR, DIODES	
CR-101	75013-5	Diode, Silicon CD12227	
CR-102	75019-2	Diode, Silicon CD6487	
CR-103	75013-4	Diode, Silicon CD12226	
CR-104	75013-4	Diode, Silicon CD12226	
CR-105	75025-2	Diode-Zener 8.2V, ±10%, 1W	
CR-201	75021-2	Diode, Silicon	
CR-202	75021-2	Diode, Silicon	
CR-301	75019-2	Diode, Silicon CD6487	
CR-302	75013-4	Diode, Silicon CD 12226	
CR-303	75013-4	Diode, Silicon CD 12226	
CR-501	75204-45	Diode, Silicon 500 PIV	
CR-502	75204-45	Diode, Silicon 500 PIV	
CR-503	75204-45	Diode, Silicon 500 PIV	
CR-504	75204-45	Diode, Silicon 500 PIV	
CR-505	75204-45	Diode, Silicon 500 PIV	
CR-506	75204-45	Diode, Silicon 500 PIV	
		F, FUSES	
F-501	66504-12	Fuse 10A SLO/BLO	
F-501	66504-10	Fuse 6¼A SLO/BLO	
		I, LAMPS	
I-101		Lamp #53 Red	
I-102		Lamp #53 Red	
		J, JACKS (Connectors) **See Also P, PLUGS**	
J-101	41110-2	Connectors, Ant., Comm.	
J-301	41143-1	Connector, Ant., Nav.	
J-501	41181-4	Connector 16 Pin	
		K, RELAY	
K-501	65126-23	Relay	
		L, INDUCTORS	
L-101	11135-9	Choke, Antenna Filter .08 µhy	
L-102	11135-9	Choke, Antenna Filter .08 µhy	
L-103	61378-101	Step Inductor	
L-104	11273-26	Coil, Ant. Comm. Rec.	Com. Rcvr.
L-105	61378-101	Step Inductor	
L-106	11412-123	Coil, RF Plate, Comm.	Com. Rcvr.
L-107	61378-101	Step Inductor	
L-108	11412-129	Coil, Mixer, Comm.	Com. Rcvr.
L-109	61406-1	Step Inductor, HF, IF Comm.	
L-110	61406-1	Step Inductor, HF, IF Comm.	
L-111	61406-1	Step Inductor, HF, IF Comm.	
L-112	11138-9	Choke, Insulated, 2.2. µhy	
L-113	11138-9	Choke, Insulated, 2.2. µhy	
L-115	11138-9	Choke, Insulated, 2.2. µhy	
L-116	11138-6	Choke, Insulated, .68 µhy	
L-201	61378-101	Step Inductor	
L-202	11627-1	Coil, Final Tank	
L-203	11138-6	Choke, Insulated, .68 µhy	
L-204	11138-8	Choke, Insulated, 1.5 µhy	
L-205	61378-101	Step Inductor	
L-206	11138-9	Choke, Insulated, 2.2 µhy	
L-207	11495-1	Coil, Second Buffer	
L-208	11138-8	Choke, Insulated, 1.5 µhy	
L-209	61378-101	Step Inductor	
L-210	11138-6	Choke, Insulated, .68 µhy	
L-211	11412-134	Coil, First Buffer	
L-212	61378-101	Step Inductor	
L-213	11138-9	Choke, Insulated, 2.2 µhy	
L-214	11503-7	Coil, Mixer	
L-215	11503-5	Coil, Doubler	Com. HFO

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
L-216	61393-101	Step Inductor, Doubler	Com. HFO
L-217	11138-9	Choke, Insulated, 2.2 μhy	Com. HFO
L-218	11412-112	Coil, Comm. HFO	Com. HFO
L-219	61393-101	Step Inductor OSC.	Com. HFO
L-220	11451-46	Choke, Insulated, 200 μhy	
L-221	11138-7	Choke, Insulated, 1.0 μhy	
L-222	11138-9	Choke, Insulated, 2.2 μhy	
L-223		Not Used	
L-224	11138-14	Choke, Insulated, 5.6 μhy	
L-225	11138-6	Choke, Insulated, .68 μhy	
L-301	11273-22	Coil, Antenna	Nav. Rcvr.
L-302	61386-1	Step Inductor	
L-303	11138-27	Choke, Insulated, .09 μhy	
L-304	61386-1	Step Inductor	
L-305	11138-27	Choke, Insulated, .09 μhy	
L-306	61386-1	Step Inductor	
L-307	61407-1	Step Inductor, HF IF	
L-308	61407-1	Step Inductor, HF IF	
L-309	11138-2	Choke, Insulated, .15 μhy	
L-310	11503-6	Coil, Nav. HFO	NAV. Rcvr.
L-311	61386-1	Step Inductor	
L-312	11359-20	Choke, Insulated, 39 μhy	Nav. LFO
L-313	11138-5	Choke, Insulated, 0.47 μhy, ±20%	Nav. LFO
L-314	11273-21	Coil, LFO	Nav. LFO
L-315	61384-1	Step Inductor, LFO	Nav. LFO
L-316	11135-10	Choke, Antenna Filter	
L-317	11446-2	Inductor Adjustable Center Tapped	
L-318	11135-10	Choke, Antenna Filter	
L-401	11814-3	Inductor, Filter	
L-501	11449-1	Choke 50 μh	

P, PLUGS (Connectors)
See also J, JACKS

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
P-101	41181-3	Connector, 16 Pin Male	
	41288-1	Cap., Plug	
P-301	41117-1	Connector, 6 Pin Female	

Q, TRANSISTORS

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
Q-101	75547-2	Transistor, Silicon NPN	
Q-201	75547-2	Transistor, Silicon NPN	
Q-202	75547-2	Transistor, Silicon NPN	
Q-203	75550-7	Transistor, NPN Silicon Planar 2N3391	
Q-204	75550-7	Transistor, Silicon NPN	
Q-301	75547-2	Transistor, NPN Silicon	
Q-302	75550-7	Transistor, NPN Silicon	
Q-303	75547-2	Transistor, NPN Silicon	
Q-304	75550-7	Transistor, NPN Silicon	
Q-401	75534-4	Transistor Driver	
Q-402	75534-3	Transistor Output	Mod. Pwr. 14V
Q-402	75511-3	Transistor Output	Mod. Pwr. 28V
Q-403	75534-3	Transistor Output	Mod. Pwr. 14V
Q-403	75511-3	Transistor Output	Mod. Pwr. 28V
Q-501	75548-3	Transistor Power 2N441	Mod. Pwr. 14V
Q-501	75505-3	Transistor Power 2N174	Mod. Pwr. 28V
Q-502	75548-3	Transistor Power 2N441	Mod. Pwr. 14V
Q-502	75505-3	Transistor Power 2N174	Mod. Pwr. 28V

R, RESISTORS

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-101	31141-103	Resistor, Carbon, 10K ohms, ±10%, ½W	
R-102	31141-473	Resistor, Carbon, 47K ohms, ±10%, ½W	
R-103	31141-221	Resistor, Carbon, 220 ohms, ±10%, ½W	
R-104	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-105	31141-473	Resistor, Carbon, 47K ohms, ±10%, ½W	
R-106	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-107	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-108	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-109	31141-821	Resistor, Carbon, 820 ohms, ±10%, ½W	
R-110	31141-470	Resistor, Carbon, 47 ohms, ±10%, ½W	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-111	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-112	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-115	31141-102	Resistor, Carbon, 1K ohms, ±10%, ½W	
R-116	31141-103	Resistor, Carbon, 10K ohms, ±10%, ½W	
R-117	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-119	31141-471	Resistor, Carbon, 470 ohms, ±10%, ½W	
R-120	31141-473	Resistor, Carbon, 47K ohms, ±10%, ½W	
R-121	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-122	31192-222	Resistor, Carbon, 2.2K ohms, ±10%, ¼W	
R-123	31192-562	Resistor, Carbon, 5.6K ohms, ±10%, ¼W	
R-124	31192-151	Resistor, Carbon, 150 ohms, ±10%, ¼W	
R-125	32033-2	Pot., 1 Meg.ohms, Vol. Cont/Sw./Squelch	
R-127	31141-471	Resistor, Carbon, 470 ohms, ±10%, ½W	
R-128	31136-470	Resistor, Carbon, 47 ohms, ±10%, 2W	
R-129	31141-271	Resistor, Carbon, 270 ohms, ±10%, ½W	
R-130	31141-395	Resistor, Carbon, 3.9 Meg. ohms, 10%, ½W	
R-131	31141-333	Resistor, Carbon, 33K ohms, ±10%, ½W	
R-132		Pot., 50K ohms, Part of R-125	
R-133	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-134	31141-820	Resistor, Carbon, 820 ohms, ±10%, ½W	
R-135	31141-561	Resistor, Carbon, 560 ohms, ±10%, ½W	
R-136	31136-151	Resistor, Carbon, 150 ohms, ±10%, 2W	
R-137	31141-102	Resistor, Carbon, 100 ohms, ±10%, ½W	
R-138	31192-470	Resistor, Carbon, 47 ohms, ±10%, ¼W	
R-139	31141-330	Resistor, Carbon, 33 ohms, ±10%, ½W	
R-201	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-202	31135-822	Resistor, Carbon, 8.2K ohms, ±10%, 1W	
R-203	31161-8	Resistor, Wirewound, 200 ohms, 3W	
R-204	31141-683	Resistor, Carbon, 68K ohms, ±10%, ½W	
R-205	31141-223	Resistor, Carbon, 22K ohms, ±10%, ½W	
R-206	31141-470	Resistor, Carbon, 47 ohms, ±10%, ½W	
R-207	31135-153	Resistor, Carbon, 15K ohms, ±10%, 1W	
R-208	31141-101	Resistor, Carbon, 100 ohms, ±10%, ¼W	
R-209	31141-183	Resistor, Carbon, 18K ohms, ±10%, ½W	
R-210	31141-470	Resistor, Carbon, 47K ohms, ±10%, ½W	
R-211	31135-182	Resistor, Carbon, 1.8K ohms, ±10%, 1W	
R-212	31141-330	Resistor, Carbon, 33 ohms, ±10%, ½W	
R-213	31192-101	Resistor, Carbon, 100 ohms, ±10%, ¼W	
R-214	31192-103	Resistor, Carbon, 10K ohms, ±10%, ¼W	
R-215	31192-274	Resistor, Carbon, 270K ohms, ±10%, ¼W	
R-216	31192-101	Resistor, Carbon, 100 ohms, ±10%, ¼W	
R-217	31192-221	Resistor, Carbon, 220 ohms, ±10%, ¼W	
R-218	31192-470	Resistor, Carbon, 47 ohms, ±10%, ¼W	
R-219	31192-332	Resistor, Carbon, 3.3K ohms, ±10%, ¼W	
R-220	31192-561	Resistor, Carbon, 560 ohms, ±10%, ¼W	
R-221	31192-152	Resistor, Carbon, 1.5K ohms, ±10%, ¼W	
R-222	31192-674	Resistor, Carbon, 470 ohms, ±10%, ¼W	
R-223	31192-103	Resistor, Carbon, 10K ohms, ±10%, ¼W	
R-224	31192-151	Resistor, Carbon, 150 ohms, ±10%, ¼W	
R-225	31192-153	Resistor, Carbon, 15K ohms, ±10%, ¼W	
R-226	31192-153	Resistor, Carbon, 15K ohms, ±10%, ¼W	
R-227	31135-393	Resistor, Carbon, 39K ohms, ±10%, 1W	
R-228	31135-273	Resistor, Carbon, 27K ohms, ±10%, 1W	
R-229	31135-273	Resistor, Carbon, 27K ohms, ±10%, 1W	
R-230	31192-103	Resistor, Carbon, 10K ohms, ±10%, ¼W	
R-231	31192-103	Resistor, Carbon, 10K ohms, ±10%, ¼W	
R-232	31192-222	Resistor, Carbon, 2.2K ohms, ±10%, ¼W	Com. HFO
R-233	31192-102	Resistor, Carbon, 1K ohms, ±10%, ¼W	
R-234	31161-20	Resistor, Wirewound, 150 ohms, 3W	
R-235	31192-101	Resistor, Carbon, 100 ohms, ±10%, ¼W	
R-236	31192-680	Resistor, Carbon, 68 ohms, ±10%, ¼W	
R-237	31175-18	Resistor, Wirewound, 15K ohms, ±5%, 7W	
R-238	31192-680	Resistor, Carbon, 68 ohms, ±10%, ¼W	

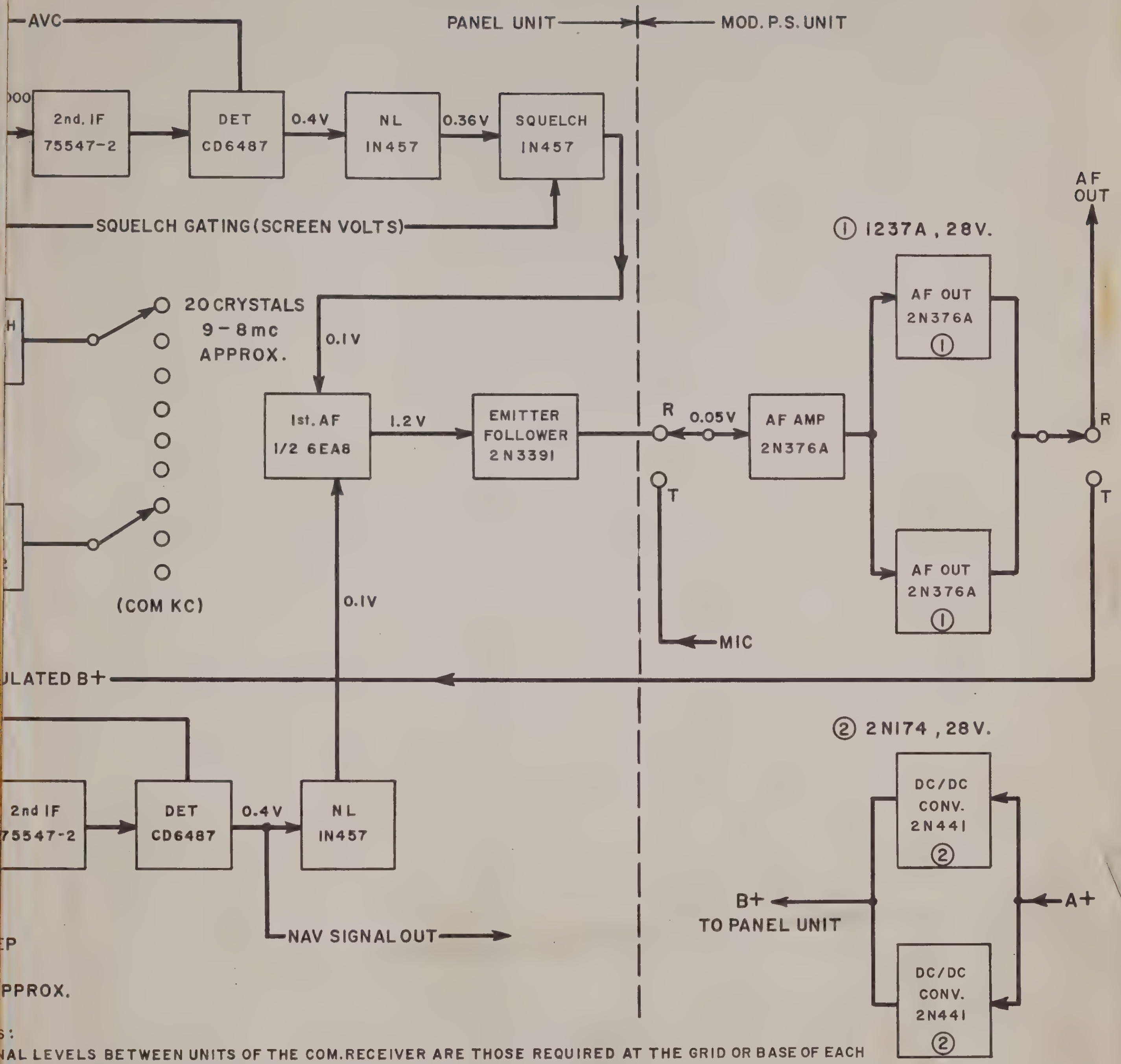
SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-301		Not used	
R-302	31141-221	Resistor, Carbon, 220 ohms, ±10%, ½W	
R-303	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-304	31141-223	Resistor, Carbon, 22K ohms, ±10%, ½W	
R-305	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-306	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-307	31141-471	Resistor, Carbon, 470 ohms, ±10%, ½W	
R-308	31141-104	Resistor, Carbon, 100K ohms, ±10%, ½W	
R-309	31192-681	Resistor, Carbon, 680 ohms, ±10%, ¼W	
R-310	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-311	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	
R-312	31192-471	Resistor, Carbon, 470 ohms, ±10%, ¼W	
R-313	31192-222	Resistor, Carbon, 2.2K ohms, ±10%, ¼W	
R-314	31192-153	Resistor, Carbon, 15K ohms, ±10%, ¼W	
R-315	31141-685	Resistor, Carbon, 6.8 Meg. ohms, ±10%, ½W	
R-316	31192-680	Resistor, Carbon, 68 ohms, ±10%, ½W	
R-317	31141-474	Resistor, Carbon, 470K ohms, ±10%, ½W	
R-318	32040-3	Potentiometer, 1 Meg. Vol. Cont.	
R-319	31192-683	Resistor, Carbon, 68K ohms, ±10%, ¼W	
R-320	31192-683	Resistor, Carbon, 68K ohms, ±10%, ¼W	
R-321	31141-153	Resistor, Carbon, 15K ohms, ±10%, ½W	
R-322	31192-392	Resistor, Carbon, 3.9K ohms, ±10%, ¼W	
R-323	31141-681	Resistor, Carbon, 680 ohms, ±10%, ½W	
R-324	31141-222	Resistor, Carbon, 2.2K ohms, ±10%, ½W	
R-325	31192-152	Resistor, Carbon, 1.5K ohms, ±10%, ¼W	
R-326	31192-332	Resistor, Carbon, 3.3K ohms, ±10%, ¼W	
R-327	31192-561	Resistor, Carbon, 560 ohms, ±10%, ¼W	
R-328	31192-101	Resistor, Carbon, 100 ohms, ±10%, ¼W.	
R-329	31135-153	Resistor, Carbon, 15K ohms, ±10%, 1W	
R-330	31141-153	Resistor, Carbon, 15K ohms, ±10%, ½W	
R-331	31192-681	Resistor, Carbon, 680 ohms ±10%, ¼W	
R-332	31192-222	Resistor, Carbon, 2.2K ohms, ±10%, ¼W	
R-333	31192-153	Resistor, Carbon, 15K ohms, ±10%, ¼W	
R-334	31192-151	Resistor, Carbon, 150 ohms, ±10%, ¼W	
R-335	31192-103	Resistor, Carbon, 10K ohms, ±10%, ¼W	
R-336	31192-680	Resistor, Carbon, 68 ohms, ±10%, ¼W	
R-337	31192-103	Resistor, Carbon, 10K ohms, ±10%, ¼W	
R-338	31192-101	Resistor, Carbon, 100 ohms, ±10%, ¼W	
R-339	31192-222	Resistor, Carbon, 2.2K ohms, ±10%, ¼W	
R-340	31192-151	Resistor, Carbon, 150 ohms, ±10%, ¼W	
R-341	31141-151	Resistor, Carbon, 150 ohms, ±10%, ¼W	
R-342	31192-220	Resistor, Carbon, 22 ohms, ±10%, ¼W	
R-401	31141-821	Resistor, Carbon, 820 ohms, ±10%, ½W	
R-402	31141-471	Resistor, Carbon, 470 ohms, ±10%, ½W	
R-403	31179-1	Resistor, Temp. Sensitive .47 ±10%, +TC	
R-404	31141-471	Resistor, Carbon, 470 ohms, ±10%, ½W	
R-405	31136-270	Resistor, Carbon, 27 ohms, ±10%, 2W	
R-406	31135-221	Resistor, Carbon, 220 ohms, ±10%, 1W	Mod. Pwr. 14V
R-406	31135-681	Resistor, Carbon, 680 ohms, ±10%, 1W..........................	Mod. Pwr. 28V
R-407	31141-151	Resistor, Carbon, 150 ohms, ±10%, ½W	Mod. Pwr. 14V
R-407	31141-221	Resistor, Carbon, 220 ohms, ±10%, ½W	Mod. Pwr. 28V
R-408	31141-822	Resistor, Carbon, 8.2K ,±10%, ½W	
R-409	31175-11	Resistor Wirewound, 75 ohms, ±5%, 5W	
R-410	32045-5	Resistor, Variable Wirewound, 2K, 2W	
R-411	31135-220	Resistor, Carbon, 22 ohms, ±10%, 1W	Mod. Pwr. 14V
R-501	31141-180	Resistor, Carbon, 18 ohms, ±10%, ½W	
R-501	31141-101	Resistor, Carbon, 100 ohms, ±10%, ½W	
R-502	31136-331	Resistor, Carbon, 330 ohms, ±10%, 2W	
R-502	31136-102	Resistor, Carbon, 1K, ±10%, 2W	
R-503	31136-331	Resistor, Carbon, 330 ohms, ±10%, 2W	Mod. Pwr. 28V
R-503	31136-102	Resistor, Carbon, 1K, ±10%, 2W	Mod. Pwr. 28V
R-504	31141-180	Resistor, Carbon, 18 ohms, ±10%, ½W	Mod. Pwr. 14V
R-504	31141-101	Resistor, Carbon, 100 ohms, ±10%, ½W	Mod. Pwr. 28V
R-505	31135-274	Resistor, Carbon, 270K, ±10%, 1W	
R-506	31136-101	Resistor, Carbon, 100 ohms, ±10%, 2W	
R-507	31175-11	Resistor, Wirewound, 75 ohms, ±5%, 5W	
R-508	31141-330	Resistor, Carbon, 33 ohms, ±10%, ½W	
R-509	31141-220	Resistor, Carbno, 22 ohms, ±10%, ½W	
R-510	31141-330	Resistor, Carbon, 33 ohms, ±10%, ½W	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		S, SWICHES	
S-101		Part of R-125	
S-102		Part of R-125	
S-103		Part of L-103	
S-105		Part of L-105	
S-107		Part of L-107	
S-109		Part of L-109	
S-110		Part of L-110	
S-111		Part of L-111	
S-201		Part of L-201	
S-202	61395-1	Switch, XTAL, HFO Comm. (Front)	
S-203	61396-1	Switch, XTAL, HFO Comm.(Rear)	
S-204		Part of S-220	
S-205		Part of L-205	
S-209		Part of L-209	
S-212		Part of L-212	
S-216		Part of L-216	
S-219		Part of L-219	
S-220	61409-101	Assembly, Switch, XTAL, Sel. KC.	
S-301	61389-1	Switch, XTAL, HFO Nav.	
S-302		Part of L-302	
S-303	61389-1	Switch	
S-304		Part of L-304	
S-305	61483-1	Switch Loc/G.S. Mc	
S-306		Part of L-306	
S-307		Part of L-307	
S-308		Part of L-308	
S-309	61482-1	Switch DME Mc	
S-310	61425-2	Switch Loc/GS/DME Kc	
S-311		Part of L-311	
S-312	61426-1	Switch Loc/GS/DME Kc	
S-313		Part of R-318	
S-315		Part of L-315	
		T, TRANSFORMERS	
T-101	11497-1	Transformer, Comm. HF IF Input	Com. Rcvr.
T-102	11502-1	Transformer, Comm. HF IF Output	Com. Rcvr.
T-103	11671-101	Transformer, Comm. LF IF Input	Com. Rcvr.
T-104	11500-1	Transformer, Comm. LF IF Interstage	Com. Rcvr.
T-105	11496-1	Transformer, Comm. LF IF Output	
T-201	11505-1	Transformer, Comm. LFO	
T-301	11672-101	Transformer, Nav. HF IF	Nav. Rcvr.
T-302	11499-1	Transformer, Nav. LF IF Input	Nav. Rcvr.
T-303	11498-1	Transformer, Nav. LF IF Output	Nav. Rcvr.
T-401	11821-102	Transformer, Driver	
T-402	11821-105	Transformer Audio Output 13.75	Mod. Pwr. 14V
T-402	11633-102	Transformer Audio Output 27.5	Mod. Pwr. 28V
T-501	11670-1	Transformer Power 13.2 V	Mod. Pwr. 14V
T-501	11629-1	Transformer Power 27.5 V	Mod. Pwr. 28V

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		V, ELECTRON TUBES	
V-101		Tube, Electron, 6BH6	
V-102		Tube, Electron, 6AK5	
V-103		Tube, Electron, 6EA8	
V-104		Tube, Electron, 6BJ6	
V-201		Tube, Electron, 7551	
V-202		Tube, Electron, 8106	
V-203		Tube, Electron, 8106	
V-204	75401-1	Tube, Electron, 6AR8 (Special)	
V-301		Tube, Electron, 6BJ6	Nav. Rcvr.
V-302		Tube, Electron, 6CB6	Nav. Rcvr.
V-303		Tube, Electron, 6CB6	Nav. Rcvr.
V-304		Tube, Electron, 6CW4	
		XT, CRYSTALS (QUARTZ)	
XT-101	~~72007-235~~	Crystal quartz submin. 63.2375 Mc, 117 Mc	Com. Transceiver
XT-102	72007-236	Crystal quartz submin. 63.7375 Mc, 118 Mc	Com. Transceiver
XT-103	72007-237	Crystal quartz submin. 64.2375 Mc, 119 Mc	Com. Transceiver
XT-104	72007-238	~~Crystal quartz submin. 64.7375 Mc, 120 Mc~~	Com. Transceiver
XT-105	72007-239	Crystal quartz submin. 65.2375 Mc, 121 Mc	Com. Transceiver
XT-106	72007-240	Crystal quartz submin. 65.7375 Mc, 122 Mc	Com. Transceiver
XT-107	72007-241	Crystal quartz submin. 66.2375 Mc, 123 Mc	Com. Transceiver
XT-108	72007-242	Crystal quartz submin. 66.7375 Mc, 124 Mc	Com. Transceiver
XT-109	72007-243	Crystal quartz submin. 67.2375 Mc, 125 Mc	Com. Transceiver
XT-110	72007-244	Crystal quartz submin. 67.7375 Mc, 126 Mc	Com. Transceiver
XT-111	72007-245	Crystal quartz submin. 68.2375 Mc, 127 Mc	Com. Transceiver
XT-112	72007-246	Crystal quartz submin. 68.7375 Mc, 128 Mc	Com. Transceiver
XT-113	72007-247	Crystal quartz submin. 69.2375 Mc, 129 Mc	Com. Transceiver
XT-114	72007-248	Crystal quartz submin. 69.7375 Mc, 130 Mc	Com. Transceiver
XT-115	72007-249	Crystal quartz submin. 70.2375 Mc, 131 Mc	Com. Transceiver
XT-116	72007-250	Crystal quartz submin. 70.7375 Mc, 132 Mc	Com. Transceiver
XT-117	72007-251	Crystal quartz submin. 71.2375 Mc, 133 Mc	Com. Transceiver
XT-118	72007-252	Crystal quartz submin. 71.7375 Mc, 134 Mc	Com. Transceiver
XT-119	72007-253	Crystal quartz submin. 72.2375 Mc, 135 Mc	Com. Transceiver
XT-120	72007-254	Crystal quartz submin. 9.475 Mc, .00 Mc	Com. Transceiver
XT-121	72007-255	Crystal quartz submin. 9.425 Mc, .05 Mc	Com. Transceiver
XT-122	72007-256	Crystal quartz submin. 9.375 Mc, .10 Mc	Com. Transceiver
XT-123	72007-257	Crystal quartz submin. 9.325 Mc, .15 Mc	Com. Transceiver
XT-124	72007-258	Crystal quartz submin. 9.275 Mc, .20 Mc	Com. Transceiver
XT-125	72007-259	Crystal quartz submin. 9.225 Mc, .25 Mc	Com. Transceiver
XT-126	72007-260	Crystal quartz submin. 9.175 Mc, .30 Mc	Com. Transceiver
XT-127	72007-261	Crystal quartz submin. 9.125 Mc, .35 Mc	Com. Transceiver
XT-128	72007-262	Crystal quartz submin. 9.075 Mc, .40 Mc	Com. Transceiver
XT-129	72007-263	Crystal quartz submin. 9.025 Mc, .45 Mc	Com. Transceiver
XT-130	72007-264	Crystal quartz submin. 8.975 Mc, .50 Mc	Com. Transceiver
XT-131	72007-265	Crystal quartz submin. 8.925 Mc, .55 Mc	Com. Transceiver
XT-132	72007-266	Crystal quartz submin. 8.875 Mc, .60 Mc	Com. Transceiver
XT-133	72007-267	Crystal quartz submin. 8.825 Mc, .65 Mc	Com. Transceiver
XT-134	72007-268	Crystal quartz submin. 8.775 Mc, .70 Mc	Com. Transceiver
XT-135	72007-269	Crystal quartz submin. 8.725 Mc, .75 Mc	Com. Transceiver

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
XT-136	72007-270	Crystal quartz submin. 8.675 Mc, .80 Mc	Com. Transceiver
XT-137	72007-271	Crystal quartz submin. 8.625 Mc, .85 Mc	Com. Transceiver
XT-138	72007-272	Crystal quartz submin. 8.575 Mc, .90 Mc	Com. Transceiver
~~XT-139~~	~~72007-273~~	~~Crystal quartz submin. 8.525 Mc, .95 Mc~~	~~Com. Transceiver~~
XT-140	72007-274	Crystal quartz submin. 96.550 Mc, 108 Mc	Com. Transceiver
XT-141	72007-275	Crystal quartz submin. 97.550 Mc, 109 Mc	Com. Transceiver
XT-142	72007-276	Crystal quartz submin. 98.550 Mc, 110 Mc	Com. Transceiver
XT-143	72007-277	Crystal quartz submin. 99.550 Mc, 111 Mc	Com. Transceiver
XT-144	72007-278	Crystal quartz submin. 100.550 Mc, 112 Mc	Com. Transceiver
XT-145	72007-279	Crystal quartz submin. 101.550 Mc, 113 Mc	Com. Transceiver
XT-146	72007-280	Crystal quartz submin. 102.550 Mc, 114 Mc	Com. Transceiver
XT-147	72007-281	Crystal quartz submin. 103.550 Mc, 115 Mc	Com. Transceiver
XT-148	72007-282	Crystal quartz submin. 104.550 Mc, 116 Mc	Com. Transceiver
XT-149	72007-283	Crystal quartz submin. 105.550 Mc, 117 Mc	Com. Transceiver
	3077-503	Kit, Crystals—90-360 Channel Conversion	Com. Transceiver

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		MISCELLANEOUS (NO SYMBOL)	
None	41147-3	Socket, Pilot Light	1-101 Panel Lamp
"	41225-2	Socket, Pilot Light	1-102 Panel Lamp
"	42033-5	Tube Socket, 7-Pin	All 7-Pin Min. Tubes
"	42034-3	Tube Socket, 9-Pin	V-103
"	42034-6	Tube Socket, 9-Pin	V-202, 203
"	42060-4	Tube Socket, 9-Pin, Recessed	V-201, 204
"	55020-2	Insulator, Transistor	Mod. Pwr. Unit
"	55520-1	Crystal Holder, Nav. Mc.	Nav. Mc.
"	56409-1	Cover, Top, Osc., Nav.	Nav. Rec.
"	56410-1	Cover, Bottom, Osc., Nav.	Nav. Rec.
"	56426-1	Cover, Bottom, Osc., Comm.	Comm.
"	56438-1	Cover, Dust	Mod. Pwr. Unit
"	56461-2	Panel, Trim	Panel Unit
"	56477-1	Cover, Top, Osc., Comm.	Comm.
"	56480-1	Strap, Grounding	Nav. Comm. Shaft
"	56482-1	Spring, Grounding	Trans. Comm.
"	61377-1	Detent, Adjustable, Nav. Kc	Nav. Kc.
"	61401-1	Detent Roller	Comm. Kc.
"	61402-1	Detent Spring	Comm. Kc.
"	61404-101	Assembly, Detent Roller	Comm. Kc.
"	66507-1	Fuse Holder	Mod. Pwr. Unit
"	81312-1	Washer, Curved Spring	Case Fastener
"	81622-3	Clip	Mod. Pwr. Unit
"	84067-3	Stud, Southco (Wing)	Case Fastener
"	84069-1	Receptacle, Southco	Case Fastener
"	84071-1	Hairpin Retainer	Case Fastener
"	84071-2	Cotter, Hairpin	Nav. Comm. Shaft
"	88129-2	Knob, Volume	Volume
"	88148-2	Knob, Squelch	Sq.


AVC
PANEL UNIT
MOD. P.S. UNIT
000
2nd. IF
75547-2
DET
CD6487
0.4V
NL
IN457
0.36V
SQUELCH
IN457
SQUELCH GATING (SCREEN VOLTS)
AF
OUT
① 1237A , 28V.
H
20 CRYSTALS
9 - 8mc
APPROX.
0.1V
AF OUT
2N376A
①
1st. AF
1/2 6EA8
1.2V
EMITTER
FOLLOWER
2N3391
R
0.05V
AF AMP
2N376A
R
T
T
2
(COM KC)
0.1V
AF OUT
2N376A
①
MIC
ULATED B+
② 2N174 , 28V.
2nd IF
75547-2
DET
CD6487
0.4V
NL
IN457
DC/DC
CONV.
2N441
②
B+
TO PANEL UNIT
A+
NAV SIGNAL OUT
EP
PPROX.
DC/DC
CONV.
2N441
②

S:

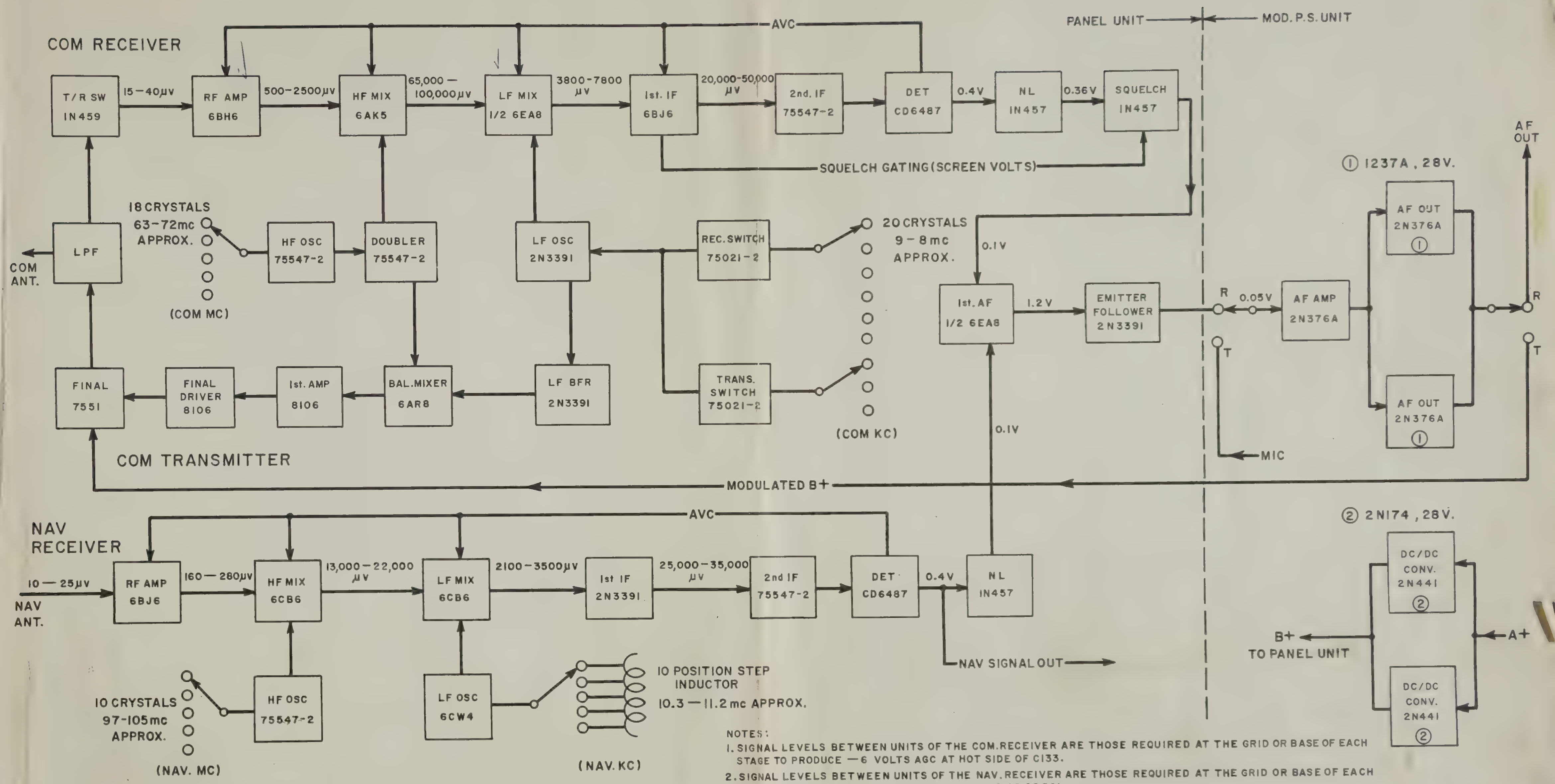
NAL LEVELS BETWEEN UNITS OF THE COM. RECEIVER ARE THOSE REQUIRED AT THE GRID OR BASE OF EACH
GE TO PRODUCE —6 VOLTS AGC AT HOT SIDE OF C133.

NAL LEVELS BETWEEN UNITS OF THE NAV. RECEIVER ARE THOSE REQUIRED AT THE GRID OR BASE OF EACH
GE TO PRODUCE —15 VOLTS AGC AT LEAD 5 OF CP301.

ABOVE SIGNALS ARE APPROXIMATE VALUES, PROVIDED FOR RAPID CHECKS. SIGNAL LEVELS DEPEND ON THE
N OF INDIVIDUAL STAGES AND ON THE INTERNAL IMPEDANCE OF THE SIGNAL GENERATOR USED.

NAL LEVELS BETWEEN UNITS OF THE AUDIO PORTIONS OF BOTH RECEIVERS AND THE COMMON AUDIO AMPLIFIERS
THOSE REQUIRED AT THE GRID OR BASE OF EACH STAGE TO PRODUCE 4.5 WATTS AUDIO OUTPUT AT 400 CPS.

Figure 28.
BLOCK DIAGRAM
narco Mark 12A COM/NAV Equipment,
with Signal Level Information.


COM RECEIVER
AVC
T/R SW IN459
15—40µv
RF AMP 6BH6
500—2500µv
HF MIX 6AK5
65,000 — 100,000µv
LF MIX 1/2 6EA8
3800-7800 µv
Ist. IF 6BJ6
20,000-50,000 µv
2nd. IF 75547-2
DET CD6487
0.4V
NL IN457
0.36V
SQUELCH IN457
SQUELCH GATING (SCREEN VOLTS)
PANEL UNIT
MOD. P.S. UNIT
AF OUT
① 1237A, 28V.
18 CRYSTALS 63-72mc APPROX.
(COM MC)
COM ANT.
LPF
HF OSC 75547-2
DOUBLER 75547-2
LF OSC 2N3391
REC. SWITCH 75021-2
20 CRYSTALS 9-8mc APPROX.
0.1V
Ist. AF 1/2 6EA8
1.2 V
EMITTER FOLLOWER 2N3391
R
0.05V
AF AMP 2N376A
AF OUT 2N376A ①
R
T
T
FINAL 7551
FINAL DRIVER 8106
Ist. AMP 8106
BAL. MIXER 6AR8
LF BFR 2N3391
TRANS. SWITCH 75021-2
(COM KC)
0.1V
MIC
COM TRANSMITTER
MODULATED B+
NAV RECEIVER
AVC
② 2N174, 28V.
10—25µv
NAV ANT.
RF AMP 6BJ6
160—280µv
HF MIX 6CB6
13,000—22,000 µv
LF MIX 6CB6
2100—3500µv
Ist IF 2N3391
25,000—35,000 µv
2nd IF 75547-2
DET CD6487
0.4V
NL IN457
DC/DC CONV. 2N441 ②
B+ TO PANEL UNIT
A+
NAV SIGNAL OUT
10 CRYSTALS 97-105mc APPROX.
HF OSC 75547-2
LF OSC 6CW4
10 POSITION STEP INDUCTOR
10.3—11.2 mc APPROX.
(NAV. MC)
(NAV. KC)

NOTES:

1. SIGNAL LEVELS BETWEEN UNITS OF THE COM. RECEIVER ARE THOSE REQUIRED AT THE GRID OR BASE OF EACH STAGE TO PRODUCE —6 VOLTS AGC AT HOT SIDE OF C133.
2. SIGNAL LEVELS BETWEEN UNITS OF THE NAV. RECEIVER ARE THOSE REQUIRED AT THE GRID OR BASE OF EACH STAGE TO PRODUCE —15 VOLTS AGC AT LEAD 5 OF CP301.
3. THE ABOVE SIGNALS ARE APPROXIMATE VALUES, PROVIDED FOR RAPID CHECKS. SIGNAL LEVELS DEPEND ON THE GAIN OF INDIVIDUAL STAGES AND ON THE INTERNAL IMPEDANCE OF THE SIGNAL GENERATOR USED.
4. SIGNAL LEVELS BETWEEN UNITS OF THE AUDIO PORTIONS OF BOTH RECEIVERS AND THE COMMON AUDIO AMPLIFIERS ARE THOSE REQUIRED AT THE GRID OR BASE OF EACH STAGE TO PRODUCE 4.5 WATTS AUDIO OUTPUT AT 400 CPS.

Figure 28.
BLOCK DIAGRAM
narco Mark 12A COM/NAV Equipment,
with Signal Level Information.

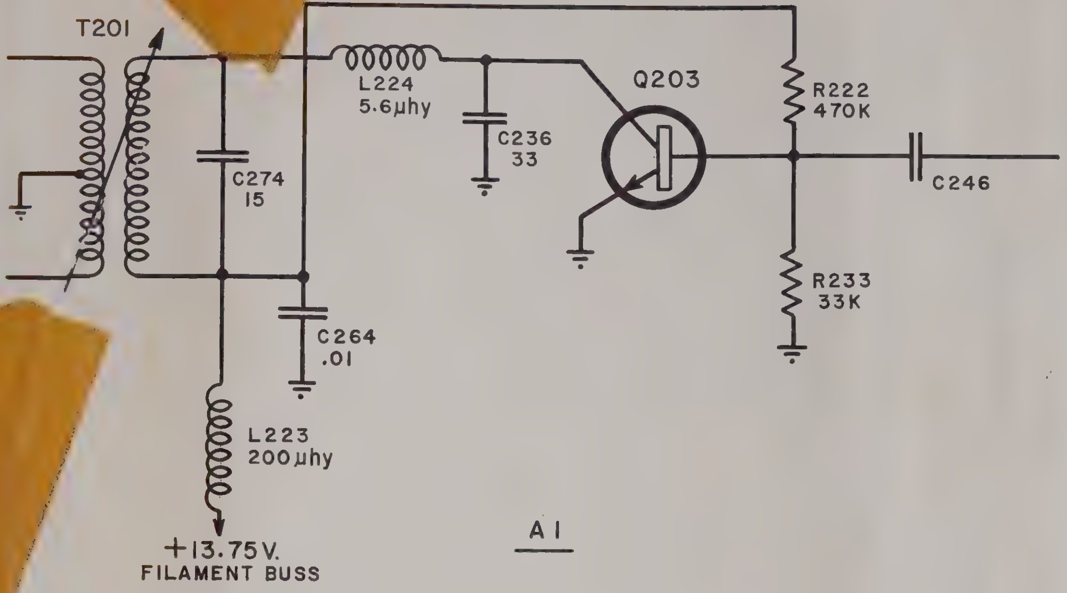

T201
L224
5.6µhy
C236
33
Q203
R222
470K
C274
15
C246
R233
33K
C264
.01
L223
200µhy
+13.75V.
FILAMENT BUSS
A1

Figure 29A.
Q-203 Circuit for Chassis Number CN144A1

16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
NT
10
J-501

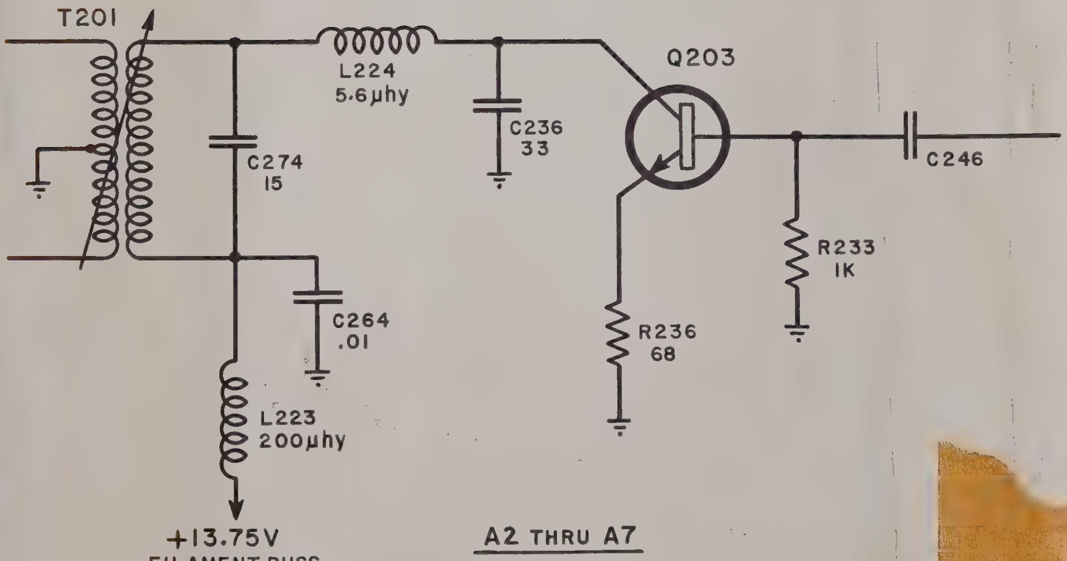
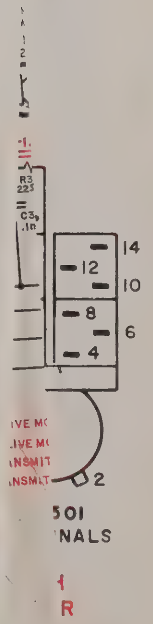

T201
L224
5.6µhy
C236
33
Q203
C274
15
C246
R233
1K
C264
.01
R236
68
L223
200µhy
+13.75V
FILAMENT BUSS
A2 THRU A7

Figure 29B.
Q-203 Circuit for Chassis Numbers CN144A2 thru A7


R3
223
C3
.1n
14
12
10
8
6
4
IVE MC
LIVE MC
NSMIT
NSMIT
2
501
NALS
R

- Extension.

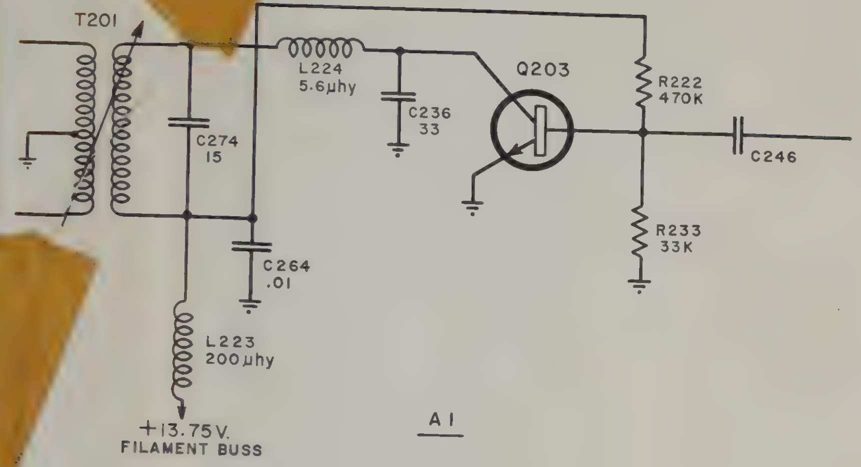

T201
L224
5.6μhy
Q203
R222
470K
C236
33
C274
15
C246
R233
33K
C264
.01
L223
200μhy
+13.75V.
FILAMENT BUSS
A1

Figure 29A.
Q-203 Circuit for Chassis Number CN144A1

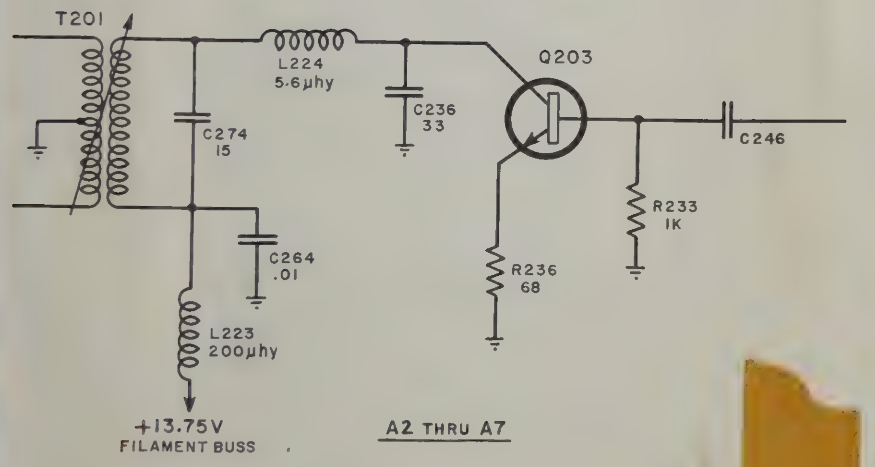
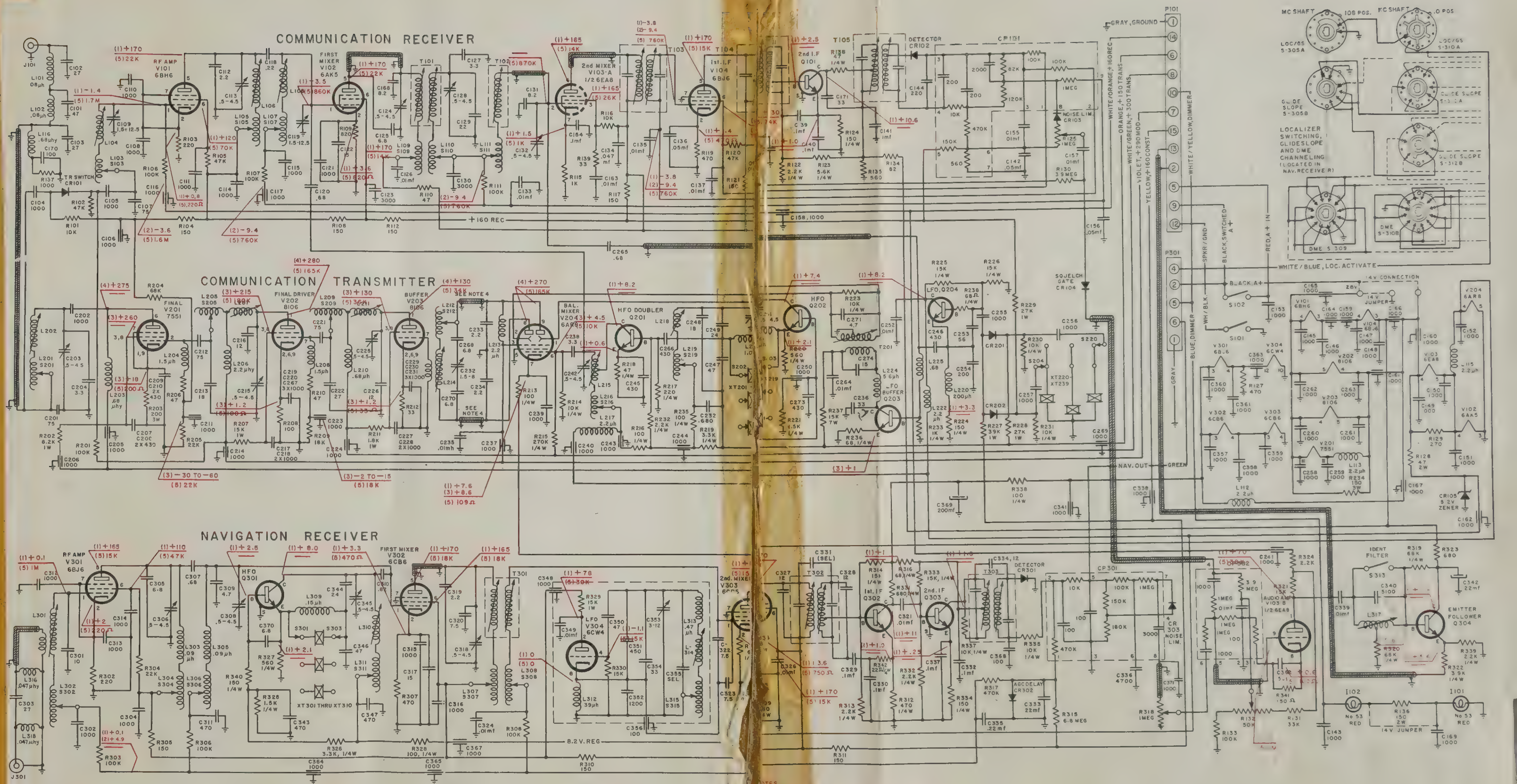
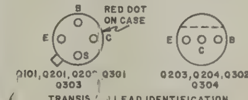

T201
L224
5.6μhy
Q203
C236
33
C274
15
C246
R233
1K
C264
.01
R236
68
L223
200μhy
+13.75V
FILAMENT BUSS
A2 THRU A7

Figure 29B.
Q-203 Circuit for Chassis Numbers CN144A2 thru A7


COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
J101
J301
P101
P301
I102
I101
8.2 V. REG
160 REC
NAV. OUT
GREEN

NOTES:
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 57/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.


B
RED DOT ON CASE
E
C
S
E
C
B
Q101, Q201, Q20 Q301
Q303
Q203, Q204, Q302
Q304

TRANSIS LEAD IDENTIFICATION
TRANSI RS VIEW FROM BOTTOM

TEST DATA

DC VOLTAGE

RESISTANCE

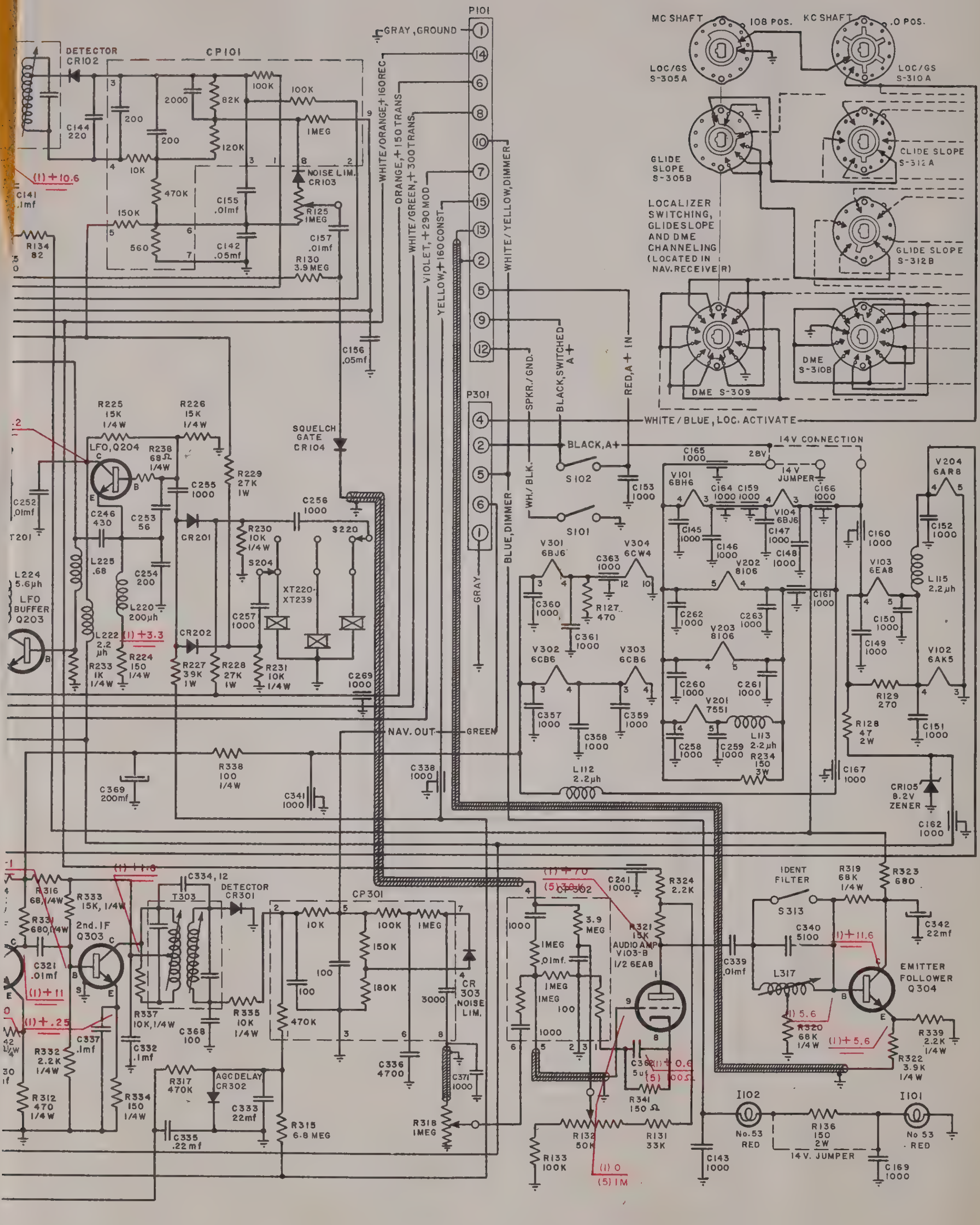
5. DATA TES
(1) DC VOLTAG REFERENCED TO GROUND, RECEIVE MODE, NO SIGNAL.
(2) DC VOLTAG REFERENCED TO GROUND, RECEIVE MODE, 20μv SIGNAL.
(3) DC VOLTAG REFERENCED TO GROUND, TRANSMIT MODE.
(4) DC VOLTAG REFERENCED TO GROUND, TRANSMIT MODE, I MEGOHM RESISTOR IN SERIES W TH VTVM PROBE.
(5) RESISTANC TO GROUND, POWER OFF.

R-02225-C
ECN-5066
6-22-66

2.5 7.7 1

Dire

Figure 29.
Schematic, ***narco*** Mark 12A,
PANEL UNIT
for CN144-A-11.
- 71 - Extension.

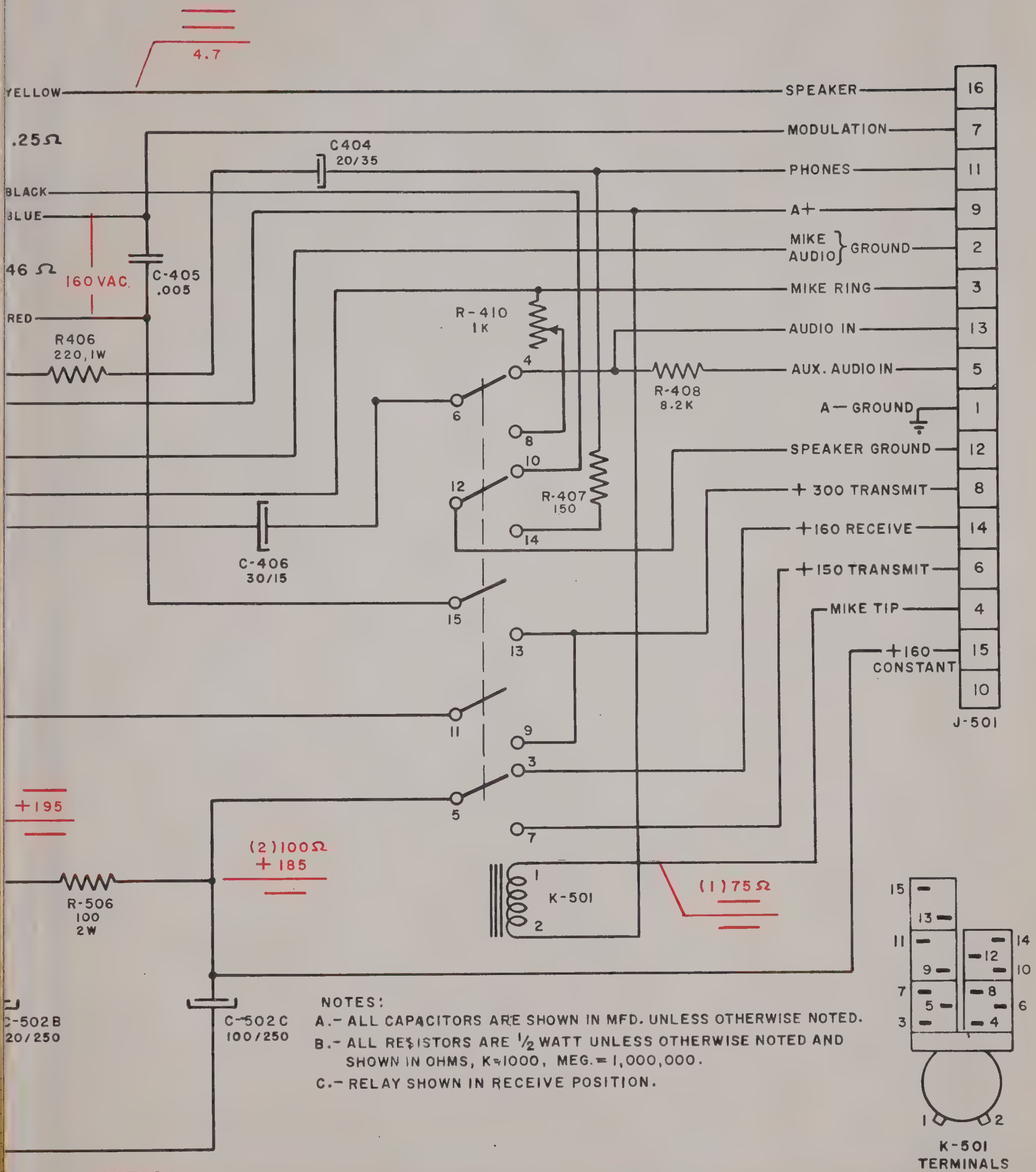

P101
GRAY, GROUND
WHITE/ORANGE, +160 REC
ORANGE, +150 TRANS
WHITE/GREEN, +300 TRANS
VIOLET, +290 MOD
YELLOW, +160 CONST
WHITE/YELLOW, DIMMER
DETECTOR CR102
CP101
C144 220
200
2000
82K
100K
100K
1MEG
120K
10K
470K
150K
560
C155 .01mf
C142 .05mf
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9MEG
(1) +10.6
C141 .1mf
R134 82
C156 .05mf
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
GLIDE SLOPE S-312B
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-309
DME S-310B
SPKR./GND.
BLACK, SWITCHED A+
RED, A+ IN
P301
WHITE/BLUE, LOC. ACTIVATE
BLACK, A+
14V CONNECTION
WH./BLK.
BLUE, DIMMER
GRAY
S102
S101
C153 1000
C165 1000
28V
14V JUMPER
V101 6BH6
C164 1000
C159 1000
V104 6BJ6
C166 1000
C145 1000
C146 1000
C147 1000
C148 1000
V202 8106
V203 8106
V201 7551
C262 1000
C263 1000
C260 1000
C261 1000
C258 1000
C259 1000
L113 2.2μh
R234 150 3W
C161 1000
V204 6AR8
C152 1000
C160 1000
V103 6EA8
L115 2.2μh
C150 1000
C149 1000
V102 6AK5
R129 270
R128 47 2W
C151 1000
C167 1000
CR105 8.2V ZENER
C162 1000
V301 6BJ6
V304 6CW4
C363 1000
C360 1000
R127 470
C361 1000
V302 6CB6
V303 6CB6
C357 1000
C358 1000
C359 1000
L112 2.2μh
R225 15K 1/4W
R226 15K 1/4W
LFO, Q204
R238 68Ω 1/4W
C255 1000
R229 27K 1W
SQUELCH GATE CR104
C256 1000
C252 .01mf
C246 430
C253 56
CR201
R230 10K 1/4W
S220
S204
XT220-XT239
L225 .68
C254 200
L224 5.6μh
LFO BUFFER Q203
L220 200μh
C257 1000
L222 2.2 μh
(1) +3.3
CR202
R224 150 1/4W
R233 1K 1/4W
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
NAV. OUT
GREEN
R338 100 1/4W
C369 200mf
C341 1000
C338 1000
R316 68 1/4W
R333 15K, 1/4W
R331 680 1/4W
2nd. IF Q303
C321 .01mf
(1) +11
(1) +.25
C334, 12
T303
DETECTOR CR301
CP301
10K
100K
1MEG
150K
180K
100
100
470K
3000
CR 303 NOISE LIM.
R337 10K, 1/4W
C368 100
R335 10K 1/4W
C337 .1mf
C332 .1mf
R332 2.2K 1/4W
R312 470 1/4W
R334 150 1/4W
R317 470K
AGC DELAY CR302
C333 .22mf
C335 .22mf
R315 6.8 MEG
C336 4700
C371 1000
R318 1MEG
(1) +70
(5) +8
C241 1000
R324 2.2K
3.9 MEG
1000
1MEG
.01mf
1MEG
1MEG
100
1000
R321 15K
AUDIO AMP V103-B 1/2 6EA8
C362 5uf
(1) +0.6
(5) 100Ω
R341 150Ω
R132 50K
R131 33K
R133 100K
(1) 0
(5) 1M
IDENT FILTER
S313
R319 68K 1/4W
R323 680
C340 5100
(1) +11.6
C342 22mf
C339 .01mf
L317
EMITTER FOLLOWER Q304
(1) 5.6
R320 68K 1/4W
(1) +5.6
R339 2.2K 1/4W
R322 3.9K 1/4W
C143 1000
I102 No.53 RED
R136 150 2W
14V. JUMPER
I101 No 53 RED
C169 1000

DE, NO SIGNAL.
DE, 20μv SIGNAL.
MODE.
MODE, 1 MEGOHM RESISTOR

2.5 7.7 1

D LFO

Figure 29.
Schematic, ***narco*** Mark 12A,
PANEL UNIT
for CN144-A-11.
- 71 - Extension.


4.7
YELLOW
SPEAKER
16
.25Ω
MODULATION
7
C404
20/35
PHONES
11
BLACK
BLUE
A+
9
46 Ω
160 VAC.
C-405
.005
MIKE
AUDIO
GROUND
2
MIKE RING
3
RED
R-410
1K
AUDIO IN
13
R406
220, 1W
4
AUX. AUDIO IN
5
R-408
8.2K
6
A — GROUND
1
8
10
SPEAKER GROUND
12
12
R-407
150
+ 300 TRANSMIT
8
14
+160 RECEIVE
14
C-406
30/15
+150 TRANSMIT
6
15
MIKE TIP
4
13
+160
CONSTANT
15
10
J-501
11
9
3
+195
5
(2) 100Ω
+ 185
7
R-506
100
2W
1
K-501
2
(1) 75Ω
15
13
11
14
12
9
10
7
8
5
6
3
4
C-502B
20/250
C-502C
100/250
1
2
K-501
TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES:

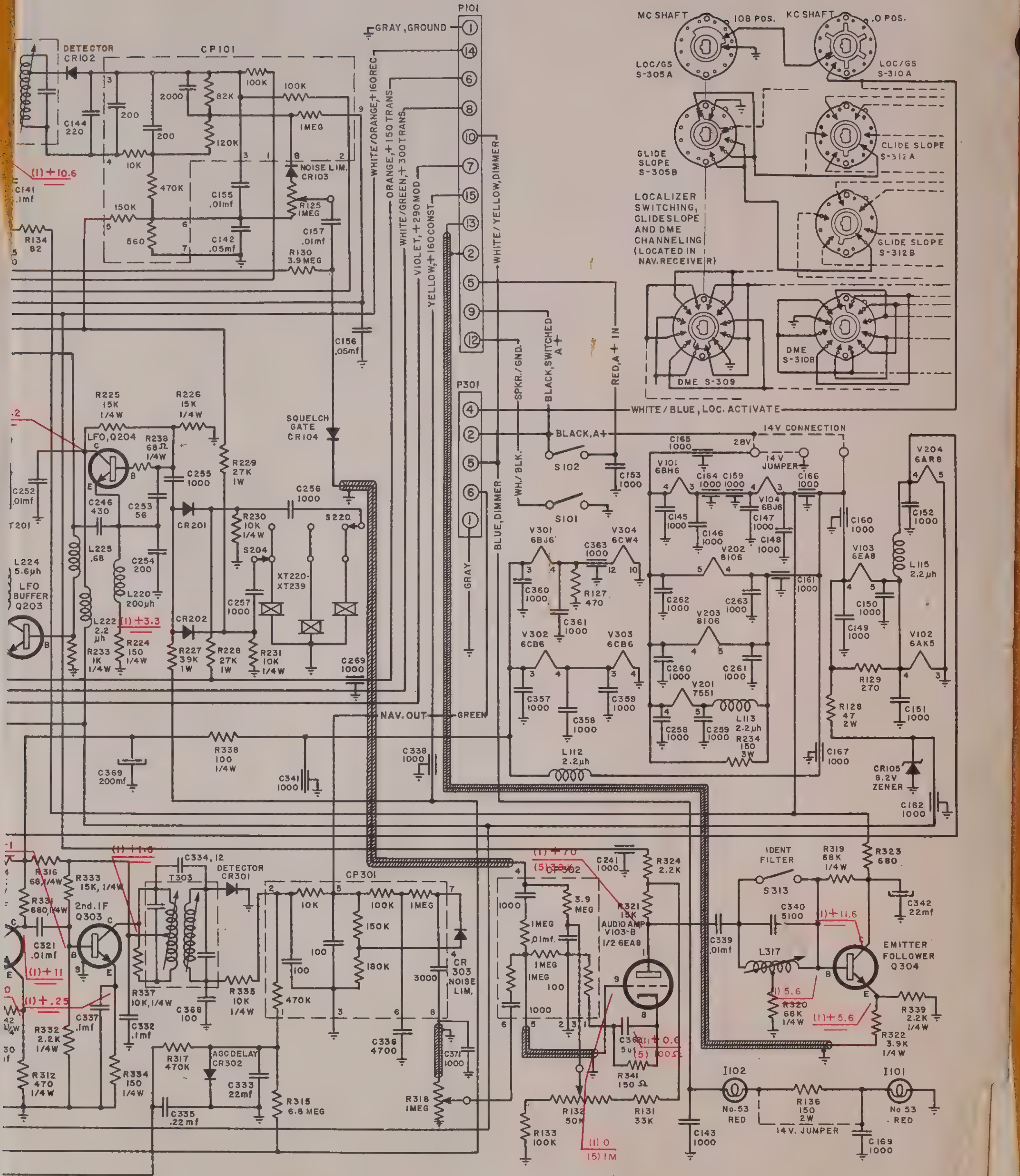
RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED. OTHER READINGS TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS AUDIO OUT, WITH NORMAL 13.75 VOLTS INTO POWER CABLE AT MARK-12A (AUDIO FREQUENCY 1000 CPS).

ALL DC MEASUREMENTS WITH RCA VOLTOMYST VTVM OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VTVM OR EQUIVALENT.

ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUIVALENT.

Figure 30.
SCHEMATIC, ***narco*** Mark 12A,
MOD-PWR UNIT T12MP-12A,
for CNPA 144-A

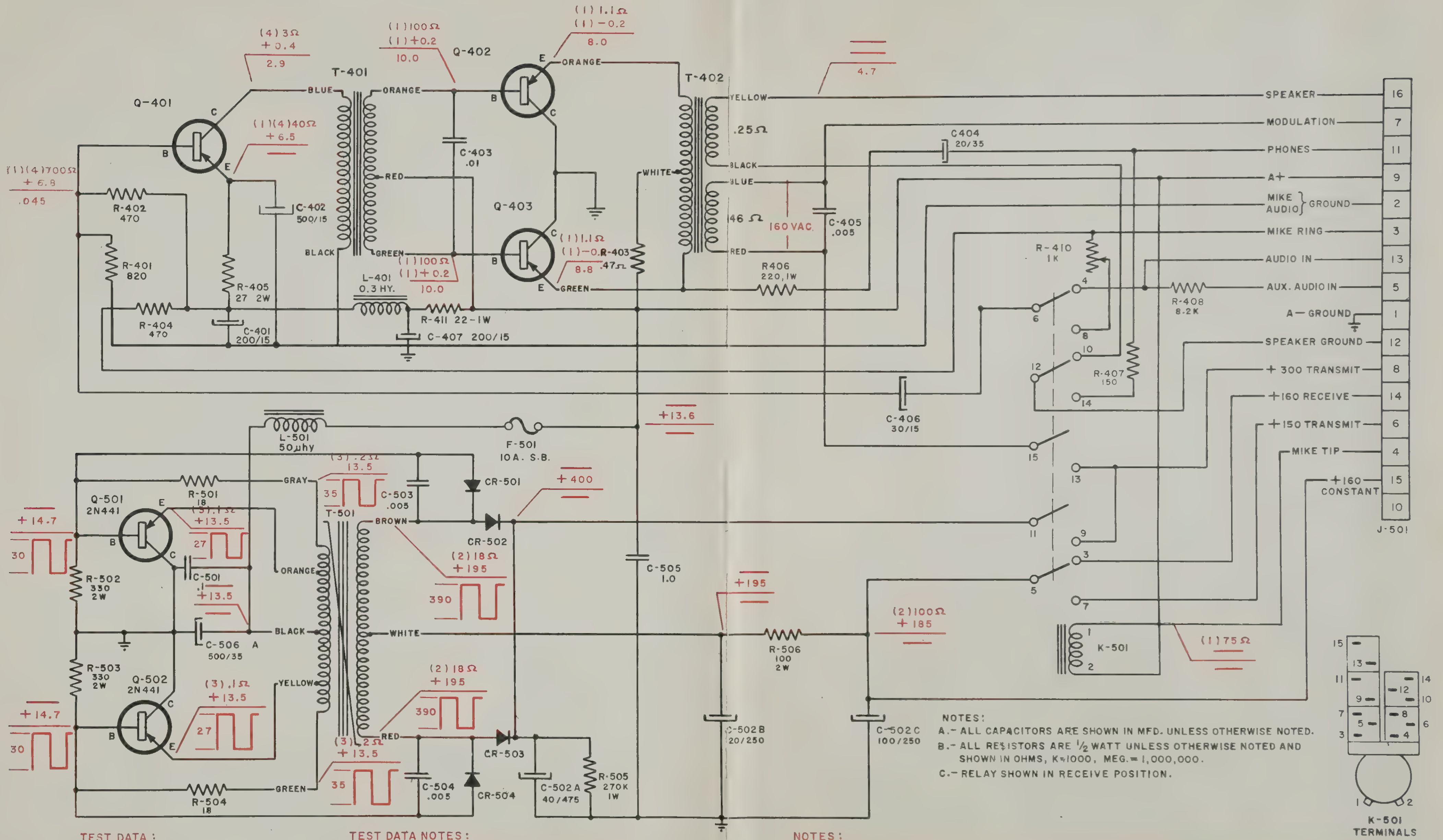

P101
GRAY, GROUND
WHITE/ORANGE, +160 REC.
ORANGE, +150 TRANS.
WHITE/GREEN, +300 TRANS.
VIOLET, +290 MOD
YELLOW, +160 CONST.
WHITE/YELLOW, DIMMER
BLUE, DIMMER
GRAY
DETECTOR CR102
CP101
C144 220
(1) +10.6
C141 .1mf
R134 82
100K
2000
82K
200
120K
10K
470K
150K
560
C155 .01mf
C142 .05mf
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9 MEG
1MEG
C156 .05mf
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
GLIDE SLOPE S-312B
DME S-309
DME S-310B
SPKR./GND.
BLACK, SWITCHED A+
RED, A+ IN
P301
WHITE/BLUE, LOC. ACTIVATE
BLACK, A+
WH./BLK.
S102
S101
14V CONNECTION
C165 1000
28V
14 V JUMPER
C153 1000
V101 6BH6
C164 1000
C159 1000
C166 1000
V104 6BJ6
C145 1000
C146 1000
C147 1000
C148 1000
C160 1000
V204 6AR8
C152 1000
V301 6BJ6
V304 6CW4
C363 1000
V202 8106
V103 6EA8
L115 2.2µh
C360 1000
R127 470
C361 1000
C262 1000
V203 8106
C263 1000
C161 1000
C150 1000
C149 1000
V102 6AK5
V302 6CB6
V303 6CB6
C260 1000
C261 1000
V201 7551
R129 270
C357 1000
C358 1000
C359 1000
C258 1000
C259 1000
L113 2.2µh
R234 150 3W
R128 47 2W
C151 1000
L112 2.2µh
C167 1000
CR105 8.2V ZENER
C162 1000
R225 15K 1/4W
R226 15K 1/4W
LFO, Q204
R238 68Ω 1/4W
R229 27K 1W
C255 1000
SQUELCH GATE CR104
C256 1000
C252 .01mf
C246 430
C253 56
CR201
R230 10K 1/4W
S220
S204
T201
L225 .68
C254 200
XT220-XT239
L224 5.6µh
LFO BUFFER Q203
L220 200µh
C257 1000
L222 2.2 µh
(1) +3.3
CR202
R233 1K 1/4W
R224 150 1/4W
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
NAV. OUT
GREEN
R338 100 1/4W
C369 200mf
C341 1000
C338 1000
R316 68, 1/4W
(1) +11.6
R333 15K, 1/4W
C334, 12
T303
DETECTOR CR301
CP301
R331 680, 1/4W
2nd. IF Q303
C321 .01mf
(1) +11
(1) +.25
R337 10K, 1/4W
C337 .1mf
R332 2.2K
C332 .1mf
C368 100
R312 470 1/4W
R334 150 1/4W
R317 470K
AGC DELAY CR302
C335 .22mf
C333 22mf
R315 6.8 MEG
10K
100K
1MEG
150K
180K
100
3000
470K
R335 10K 1/4W
CR 303 NOISE LIM.
C336 4700
C371 1000
R318 1MEG
(1) +70
(5) +38
C302
C241 1000
R324 2.2K
1000
3.9 MEG
R321 15K
AUDIO AMP V103-B 1/2 6EA8
1MEG
.01mf
1MEG
100
1000
C362 5uf
(1) +0.6
(5) 100
R341 150 Ω
R132 50K
R131 33K
R133 100K
(1) 0
(5) 1M
C143 1000
IDENT FILTER
S313
R319 68K 1/4W
R323 680
C342 22mf
C340 5100
C339 .01mf
L317
(1) +11.6
EMITTER FOLLOWER Q304
(1) 5.6
R320 68K 1/4W
(1) +5.6
R339 2.2K 1/4W
R322 3.9K 1/4W
I102
No. 53 RED
R136 150 2W
14 V. JUMPER
I101
No 53 RED
C169 1000

DE, NO SIGNAL.
DE, 20µv SIGNAL.
MODE.
MODE, 1 MEGOHM RESISTOR

2.5 7.7 1

D LFO

Figure 29.
Schematic, ***narco*** Mark 12A,
PANEL UNIT
for CN144-A-11.
- 71 - Extension.


Q-401
T-401
Q-402
T-402
Q-403
(4) 3Ω
+ 0.4
2.9
(1) 100Ω
(1) + 0.2
10.0
(1) 1.1Ω
(1) − 0.2
8.0
4.7
(1)(4) 40Ω
+ 6.5
(1)(4) 700Ω
+ 6.8
.045
R-402
470
R-401
820
R-404
470
R-405
27 2W
C-402
500/15
C-401
200/15
C-403
.01
L-401
0.3 HY.
R-411 22-1W
C-407 200/15
(1) 100Ω
(1) + 0.2
10.0
(1) 1.1Ω
(1) − 0.2
8.8
R-403
.47Ω
.25Ω
46Ω
160 VAC
C-405
.005
C404
20/35
R406
220, 1W
R-410
1K
R-408
8.2K
R-407
150
C-406
30/15
BLUE
ORANGE
RED
BLACK
GREEN
WHITE
YELLOW
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A − GROUND
SPEAKER GROUND
+ 300 TRANSMIT
+ 160 RECEIVE
+ 150 TRANSMIT
MIKE TIP
+ 160 CONSTANT
J-501
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
L-501
50 μhy
F-501
10A. S.B.
+ 13.6
+ 400
Q-501
2N441
Q-502
2N441
R-501
18
R-502
330
2W
R-503
330
2W
R-504
18
C-501
C-506 A
500/35
T-501
C-503
.005
C-504
.005
CR-501
CR-502
CR-503
CR-504
C-505
1.0
C-502 A
40/475
R-505
270K
1W
C-502 B
20/250
C-502 C
100/250
R-506
100
2W
K-501
+ 14.7
30
(3) .1Ω
+ 13.5
27
(3) .2Ω
13.5
35
(2) 18Ω
+ 195
390
(2) 100Ω
+ 185
(1) 75Ω
+ 195
K-501
TERMINALS

NOTES:

A.− ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.− ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.

C.− RELAY SHOWN IN RECEIVE POSITION.

TEST DATA:

RESISTANCE

DC VOLTAGE & POLARITY

AC VOLTAGE OR WAVESHAPE AND P-P VOLTAGE

TEST DATA NOTES:

(1) MEASURED WITH RESPECT TO A+, PIN 9.

(2) MEASURED WITH RESPECT TO WHITE LEAD OF T501.

(3) MEASURED WITH RESPECT TO BLACK LEAD OF T501.

(4) MEASURED WITH Q-401 REMOVED.

NOTES:

RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED. OTHER READINGS TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS AUDIO OUT, WITH NORMAL 13.75 VOLTS INTO POWER CABLE AT MARK-12A (AUDIO FREQUENCY 1000 CPS).

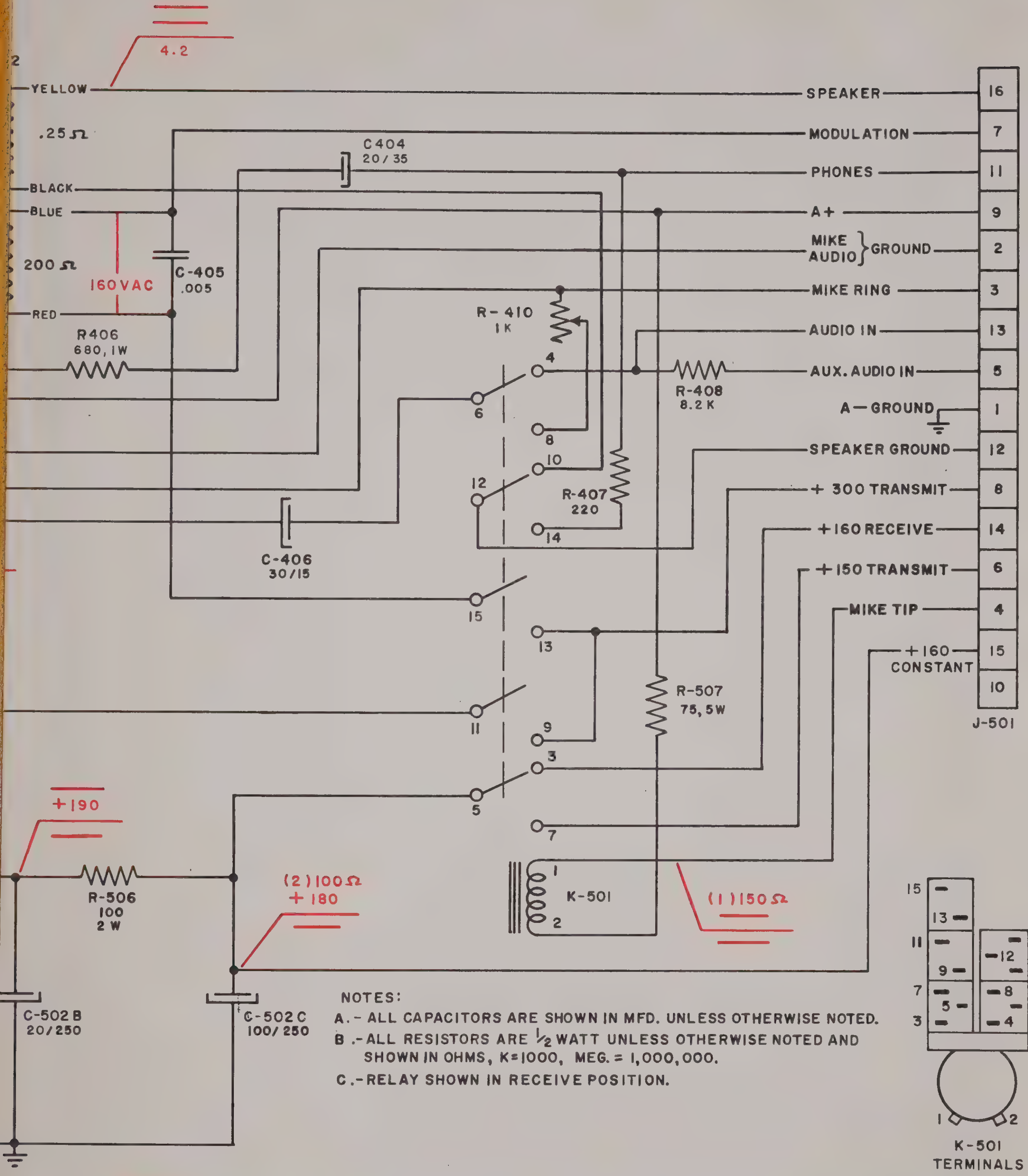
ALL DC MEASUREMENTS WITH RCA VOLTOMYST VTVM OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VTVM OR EQUIVALENT.

ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUIVALENT.

T-02211
ECN-0000
6-26-65

Figure 30.
SCHEMATIC, *narco* Mark 12A,
MOD-PWR UNIT T12MP-12A,
for CNPA 144-A


4.2
2
YELLOW
.25 Ω
BLACK
BLUE
200 Ω
160 VAC
RED
R406
680, 1W
C404
20/35
C-405
.005
SPEAKER
MODULATION
PHONES
A+
MIKE
AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A—GROUND
SPEAKER GROUND
+ 300 TRANSMIT
+160 RECEIVE
+ 150 TRANSMIT
MIKE TIP
+160
CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
R-410
1K
R-408
8.2 K
R-407
220
C-406
30/15
4
6
8
10
12
14
15
13
11
9
3
5
7
R-507
75, 5W
K-501
1
2
(1) 150 Ω
(2) 100 Ω
+ 180
+190
R-506
100
2 W
C-502 B
20/250
C-502 C
100/250
15
13
11
9
7
5
3
14
12
10
8
6
4
1
2
K-501
TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES:

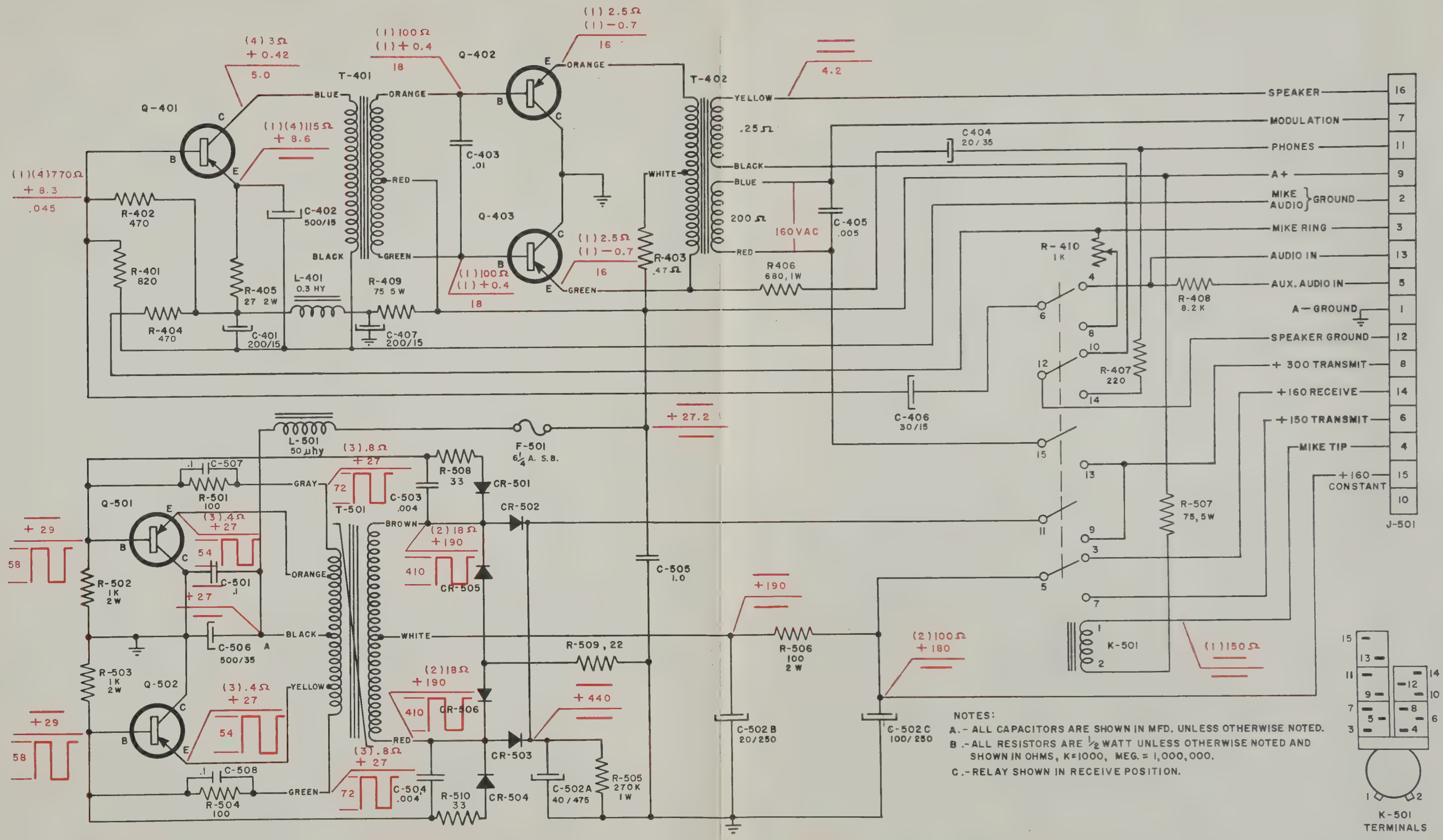
RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED. OTHER READINGS TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS AUDIO OUT, WITH NORMAL 27.50 VOLTS INTO POWER CABLE AT MARK-12A (AUDIO FREQUENCY 1000 CPS).

ALL DC MEASUREMENTS WITH RCA VOLTOMYST VTVM OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VTVM OR EQUIVALENT.

ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUIVALENT.

Figure 31.
SCHEMATIC, *narco* Mark 12A,
MOD-PWR UNIT, T-24MP-12A,
for CNPB 144-A.
- 75 - Extension.


Q-401
Q-402
Q-403
Q-501
Q-502
T-401
T-402
T-501
L-401 0.3 HY
L-501 50 μhy
F-501 6¼ A. S.B.
R-401 820
R-402 470
R-403 .47 Ω
R-404 470
R-405 27 2W
R406 680, 1W
R-407 220
R-408 8.2 K
R-409 75 5W
R-410 1K
R-501 100
R-502 1K 2W
R-503 1K 2W
R-504 100
R-505 270K 1W
R-506 100 2W
R-507 75, 5W
R-508 33
R-509, 22
R-510 33
C-401 200/15
C-402 500/15
C-403 .01
C404 20/35
C-405 .005
C-406 30/15
C-407 200/15
C-501 .1
C-502A 40/475
C-502B 20/250
C-502C 100/250
C-503 .004
C-504 .004
C-505 1.0
C-506 500/35
C-507 .1
C-508 .1
CR-501
CR-502
CR-503
CR-504
CR-505
CR-506
K-501
J-501
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A-GROUND
SPEAKER GROUND
+300 TRANSMIT
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160 CONSTANT
160VAC
.25 Ω
200 Ω
+27.2
+190
+440
(2) 100 Ω +180
(1) 150 Ω
K-501 TERMINALS

NOTES:
A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.
B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.
C.- RELAY SHOWN IN RECEIVE POSITION.

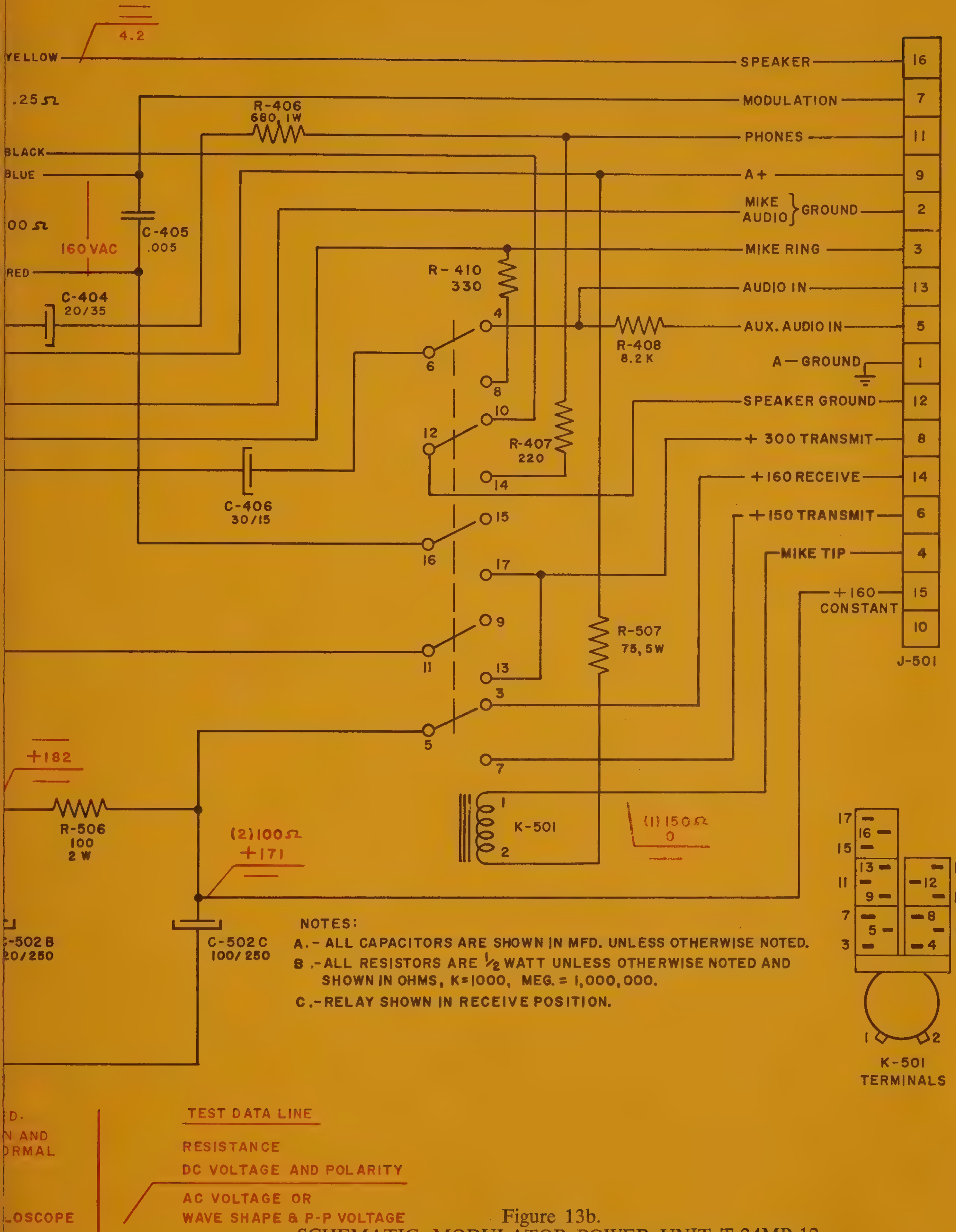
TEST DATA:
RESISTANCE
DC VOLTAGE & POLARITY
AC VOLTAGE OR WAVESHAPE AND P-P VOLTAGE

TEST DATA NOTES:
(1) MEASURED WITH RESPECT TO A+, PIN 9.
(2) MEASURED WITH RESPECT TO WHITE LEAD OF T501.
(3) MEASURED WITH RESPECT TO BLACK LEAD OF T501.
(4) MEASURED WITH Q-401 REMOVED.

NOTES:
RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED. OTHER READINGS TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS AUDIO OUT, WITH NORMAL 27.50 VOLTS INTO POWER CABLE AT MARK-12A (AUDIO FREQUENCY 1000 CPS).
ALL DC MEASUREMENTS WITH RCA VOLTOMYST VTVM OR EQUIVALENT.
ALL AC MEASUREMENTS WITH BALLANTINE AC VTVM OR EQUIVALENT.
ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUIVALENT.

T-02212
ECN-0000
6-25-66

Figure 31.
SCHEMATIC, *narco* Mark 12A,
MOD-PWR UNIT, T-24MP-12A,
for CNPB 144-A.
- 75 - Extension.


4.2
YELLOW
SPEAKER
16
.25 Ω
MODULATION
7
R-406
680, 1W
PHONES
11
BLACK
BLUE
A+
9
MIKE
AUDIO
GROUND
2
00 Ω
160 VAC
C-405
.005
RED
MIKE RING
3
R-410
330
AUDIO IN
13
C-404
20/35
4
AUX. AUDIO IN
5
R-408
8.2 K
6
A— GROUND
1
8
SPEAKER GROUND
12
10
12
R-407
220
+ 300 TRANSMIT
8
14
+160 RECEIVE
14
C-406
30/15
15
+150 TRANSMIT
6
16
MIKE TIP
4
17
+160
CONSTANT
15
10
J-501
9
R-507
75, 5W
11
13
3
5
7
+182
R-506
100
2 W
1
K-501
2
(1) 150 Ω
0
(2) 100 Ω
+171
17
16
15
13
11
9
7
5
3
14
12
10
8
6
4
1
2
K-501
TERMINALS
-502 B
20/250
C-502 C
100/ 250
D.
N AND
ORMAL
LOSCOPE
OR
TEST DATA LINE
RESISTANCE
DC VOLTAGE AND POLARITY
AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

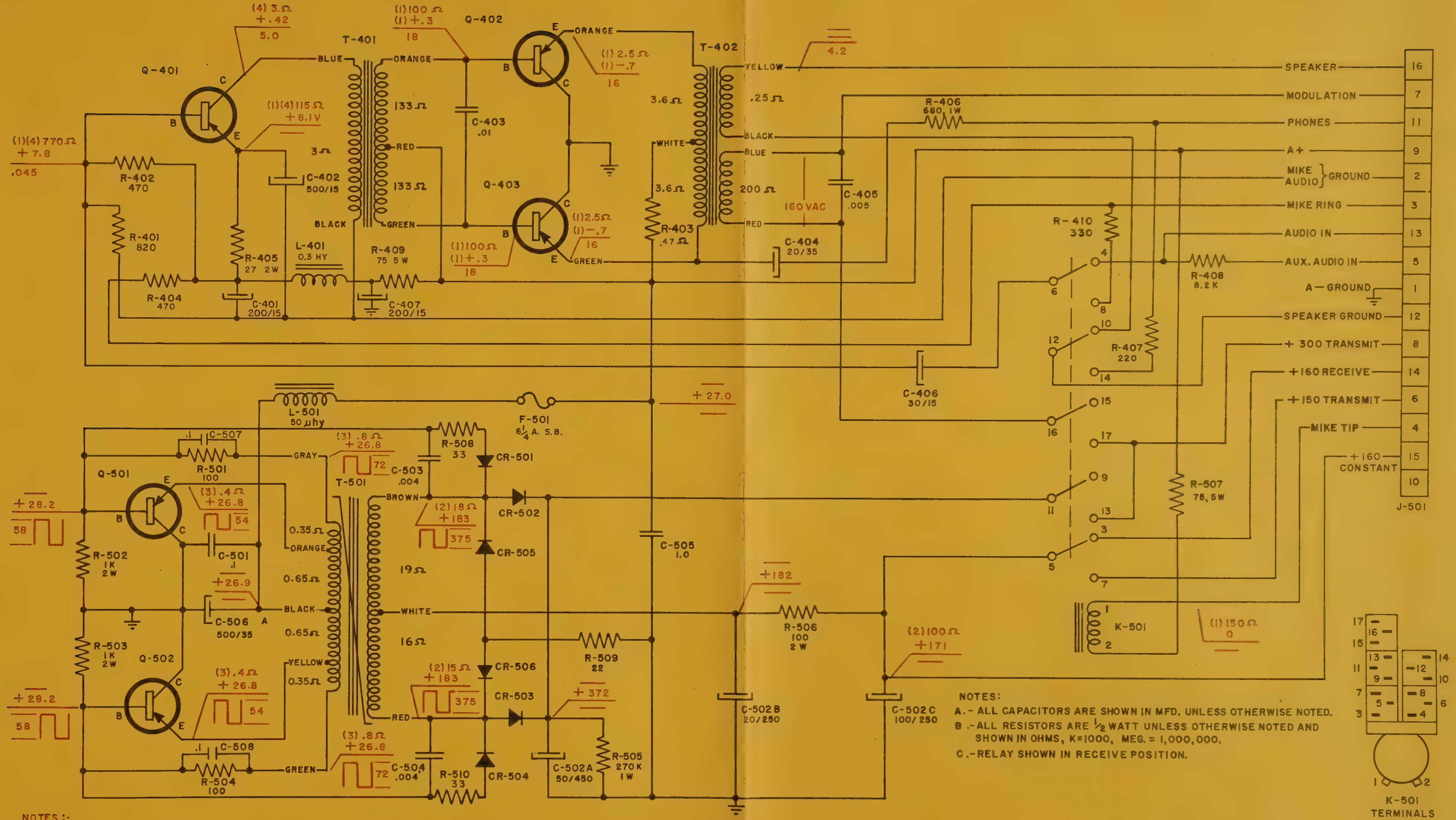
NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

Figure 13b.
SCHEMATIC, MODULATOR POWER UNIT T-24MP-12
for *narco* Mark-12 operation on 24 Volts.
CNPB89-C & D


Q-401
Q-402
Q-403
Q-501
Q-502
T-401
T-402
T-501
L-401
0.3 HY
L-501
50 µhy
F-501
6¼ A. S.B.
R-401
820
R-402
470
R-404
470
R-405
27 2W
R-409
75 5W
R-403
.47 Ω
R-406
680, 1W
R-407
220
R-408
8.2 K
R-410
330
R-501
100
R-502
1K
2W
R-503
1K
2W
R-504
100
R-505
270K
1W
R-506
100
2W
R-507
75, 5W
R-508
33
R-509
22
R-510
33
C-401
200/15
C-402
500/15
C-403
.01
C-404
20/35
C-405
.005
C-406
30/15
C-407
200/15
C-501
.1
C-502A
50/450
C-502 B
20/250
C-502 C
100/250
C-503
.004
C-504
.004
C-505
1.0
C-506
500/35
C-507
.1
C-508
.1
CR-501
CR-502
CR-503
CR-504
CR-505
CR-506
K-501
J-501
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A—GROUND
SPEAKER GROUND
+300 TRANSMIT
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160 CONSTANT
ORANGE
BLUE
RED
GREEN
BLACK
YELLOW
WHITE
GRAY
BROWN
160 VAC
+27.0
+182
+372
4.2
(1)(4) 770Ω
+7.8
.045
+28.2
58
K-501 TERMINALS

NOTES:
A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.
B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.
C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES :-
(1) - MEASURED WITH RESPECT TO A+, PIN-9.
(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.
(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.
(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS OF AUDIO OUT (FREQUENCY 1000 CYCLES), WITH NORMAL 27.5V. INTO POWER CABLE AT MARK-12.

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE
RESISTANCE
DC VOLTAGE AND POLARITY
AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Figure 13b.
SCHEMATIC, MODULATOR POWER UNIT T-24MP-12
for *narco* Mark-12 operation on 24 Volts.
CNPB89-C & D

narco MARK-12
VHF Transceiver

with
NAVIGATION RECEIVER
and
T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL
SUPPLEMENT No. 4

FOR PANEL UNITS:
CN89-G.
CNP89-G.

INTRODUCTION

This supplement is concerned with a change in the balanced mixer (V-204) output circuit.

CONTENTS

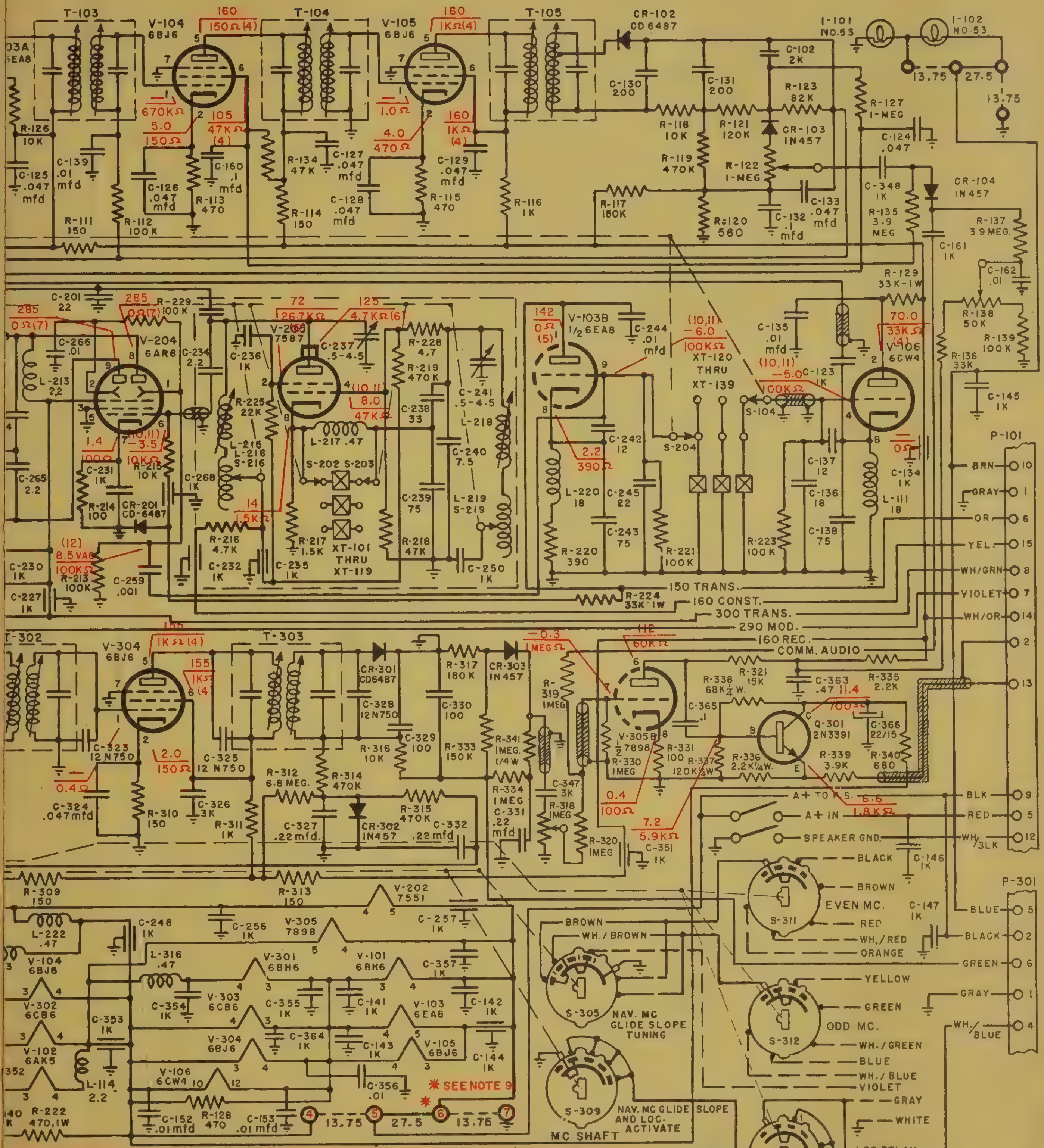
Schematic .... Page 119

CHANGES

C-225	Deleted.
C-226	Deleted and replaced by bus wire.
C-229	Deleted and replaced by bus wire.
L-213	Changed from 0.33 μh to 2.2 μh. Part No. is now ***narco*** 11138-9.
L-214	A link coupling winding was added. Part No. is now ***narco*** 11412-136.
L-227	Deleted.
R-212	Deleted.

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

d in U.S.A.


T-103
V-104
6BJ6
160
150Ω(4)
T-104
V-105
6BJ6
160
1KΩ(4)
T-105
CR-102
CD6487
I-101
NO.53
I-102
NO.53
C-102
2K
13.75
27.5
13.75
C-130
200
C-131
200
R-123
82K
R-127
1-MEG
670KΩ
5.0
150Ω
105
47KΩ
(4)
1.0Ω
4.0
470Ω
160
1KΩ
(4)
R-118
10K
R-121
120K
CR-103
IN457
C-124
.047
R-126
10K
C-139
.01
mfd
C-125
.047
mfd
C-160
.1
mfd
C-126
.047
mfd
R-113
470
R-134
47K
C-127
.047
mfd
C-128
.047
mfd
C-129
.047
mfd
R-115
470
R-116
1K
R-119
470K
R-122
1-MEG
R-117
150K
R-120
560
C-132
.1
mfd
C-133
.047
mfd
C-348
1K
R-135
3.9
MEG
CR-104
IN457
R-137
3.9 MEG.
C-161
1K
R-111
150
R-112
100K
R-114
150
R-129
33K-1W
C-162
.01
C-201
22
285
0Ω(7)
285
0Ω(7)
R-229
100K
V-204
6AR8
72
26.7KΩ
V-203
7587
125
4.7KΩ(6)
R-228
4.7
R-219
470K
C-237
.5-4.5
142
0Ω
(5)
V-103B
1/2 6EA8
C-244
.01
mfd
(10,11)
-6.0
100KΩ
XT-120
THRU
XT-139
C-135
.01
mfd
70.0
33KΩ
(4)
V-106
6CW4
R-138
50K
R-139
100K
R-136
33K
C-266
.01
L-213
22
C-234
2.2
C-236
1K
R-225
22K
(10,11)
8.0
47KΩ
C-238
33
C-241
.5-4.5
L-218
(10,11)
-5.0
100KΩ
C-123
1K
S-104
C-145
1K
1.4
100Ω
(10,11)
-3.5
10KΩ
R-215
10K
L-216
S-216
L-217 .47
S-202
S-203
C-240
7.5
C-242
12
2.2
390Ω
S-204
C-137
12
C-136
18
0Ω
C-134
1K
P-101
BRN
GRAY
OR
YEL.
WH/GRN
VIOLET
WH/OR
C-265
2.2
C-231
1K
R-214
100
CR-201
CD-6487
C-268
1K
14
1.5KΩ
L-215
C-239
75
L-219
S-219
L-220
18
C-245
22
L-111
18
C-138
75
(12)
8.5VAC
100KΩ
R-213
100K
R-216
4.7K
R-217
1.5K
XT-101
THRU
XT-119
R-218
47K
C-250
1K
R-220
390
C-243
75
R-221
100K
R-223
100K
C-230
1K
C-227
1K
C-259
.001
C-232
1K
C-235
1K
150 TRANS.
R-224
33K 1W
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM. AUDIO
T-302
V-304
6BJ6
155
1KΩ(4)
T-303
155
1KΩ
(4)
CR-301
CD6487
R-317
180K
CR-303
IN457
-0.3
1MEGΩ
112
60KΩ
R-319
1MEG
R-338
68K 1/4 W.
R-321
15K
C-363
.47
11.4
R-335
2.2K
C-328
12N750
C-330
100
C-365
.1
V-305B
1/2 7898
700
Q-301
2N3391
C-366
22/15
C-323
12 N750
2.0
150Ω
C-325
12 N750
C-329
100
R-316
10K
R-333
150K
R-341
1MEG.
1/4 W
R-330
1MEG
R-331
100
R-337
120K 1/4 W
R-336
2.2K 1/4W.
R-339
3.9K
R-340
680
0.4Ω
C-324
.047mfd
R-310
150
C-326
3K
R-312
6.8 MEG.
R-314
470K
R-315
470K
R-334
1MEG
C-347
3K
R-318
1MEG
0.4
100Ω
7.2
5.9KΩ
A+ TO P.S.
6.6
1.8KΩ
BLK
A+ IN
RED
SPEAKER GND.
WH/BLK
R-311
1K
C-327
.22mfd.
CR-302
IN457
C-332
.22mfd
C-331
.22
mfd
R-320
1MEG
C-351
1K
C-146
1K
R-309
150
R-313
150
V-202
7551
BLACK
BROWN
EVEN MC.
S-311
RED
WH./RED
ORANGE
C-147
1K
P-301
BLUE
BLACK
GREEN
GRAY
WH./BLUE
L-222
.47
C-248
1K
C-256
1K
V-305
7898
C-257
1K
BROWN
WH./BROWN
V-104
6BJ6
L-316
.47
V-301
6BH6
V-101
6BH6
C-357
1K
YELLOW
V-302
6CB6
C-354
1K
V-303
6CB6
C-355
1K
C-141
1K
V-103
6EA8
C-142
1K
S-305
NAV. MC
GLIDE SLOPE
TUNING
GREEN
ODD MC.
S-312
V-102
6AK5
C-353
1K
V-304
6BJ6
C-364
1K
C-143
1K
V-105
6BJ6
C-144
1K
WH./GREEN
BLUE
WH./BLUE
VIOLET
L-114
2.2
V-106
6CW4
C-356
.01
SEE NOTE 9
GRAY
WHITE
R-222
470,1W
C-152
.01mfd
R-128
470
C-153
.01 mfd
13.75
27.5
13.75
S-309
NAV. MC GLIDE SLOPE
AND LOC.
ACTIVATE
MC SHAFT
NAV. KC
ODD
EVEN
S-313
KC SHAFT
LOC.RELAY
C-358
1K

ASURED TO TERMINAL 15 OF P-101.
ASURED TO TERMINAL 8 OF P-101.
ASURED TO TERMINAL 7 OF P-101.
RMINALS 4,5,6 AND 7 ARE LOCATED
THE 8 TERMINAL TIE LUG STRIP
UNTED BENEATH THE VOLUME CON-
ROLS. VIEWED FROM FRONT, TERM-
ALS ARE NUMBERED FROM RIGHT TO LEFT.

10. VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ± 20% CAN BE EXPECTED.
11. MEASURED THRU A 1 MEG. OHM RESISTOR.
12. MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10MC) VOLTMETER.
13. VOLTAGE SHOWN ABOVE LINE. EXAMPLE VOLTAGE / RESISTANCE

Figure 11d.
SCHEMATIC, *narco* Mark-12, PANEL UNIT
For CN89-G and CNP89-G.

A. INTRODUCTION.

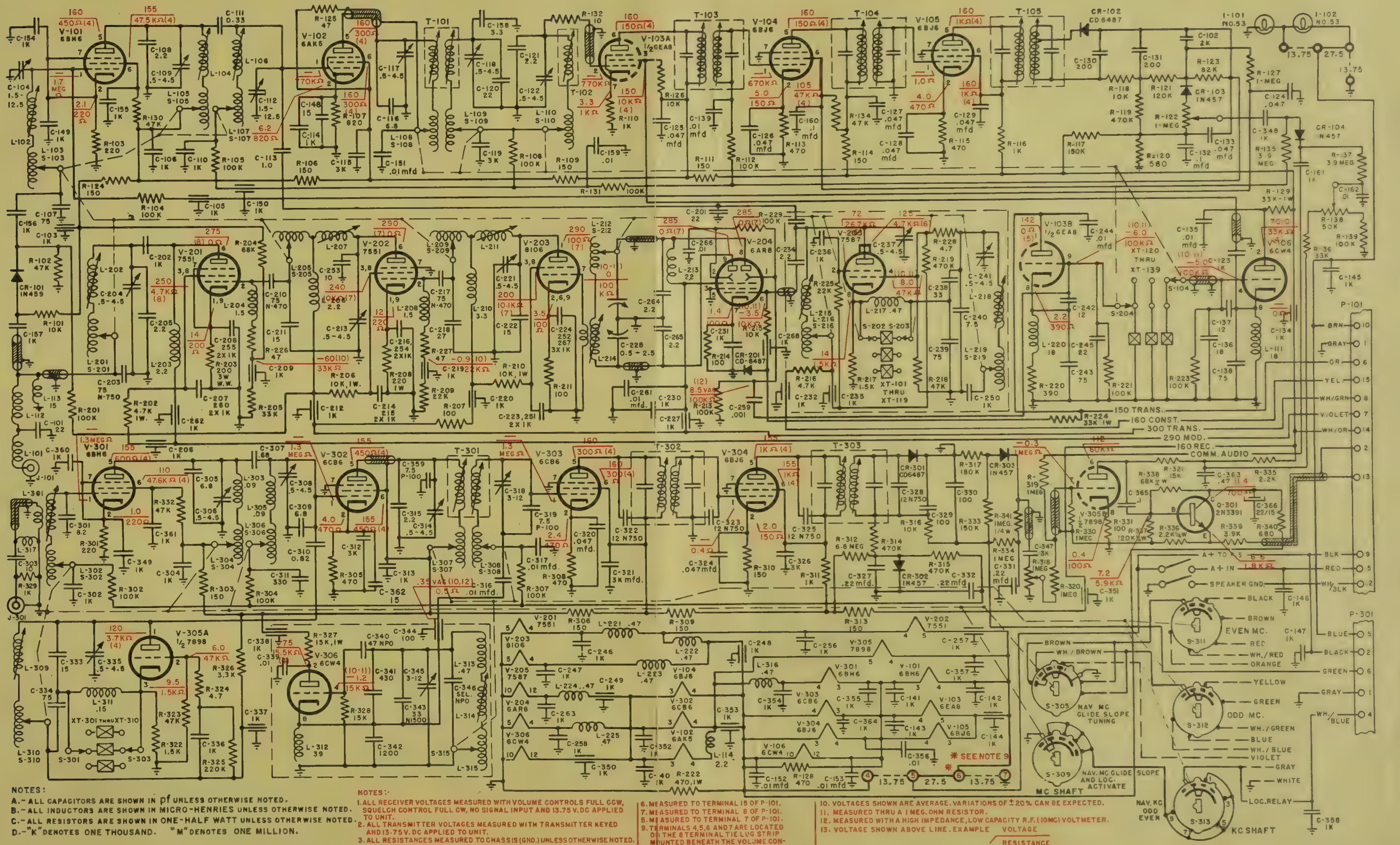
The Panel Unit Schematic in this supplement is concerned primarily with a change in the balanced mixer (V-204) output circuit. For details see the cover sheet, page 117.

NOTE:

Because of a lack of space the functions of S-311 and S-312, near the lower right of Fig. 11d. on this sheet, are not fully stated.

S-311 "EVEN MC" means: "EVEN whole Mc Channels (108 Mc. or 110 Mc.) associated with the ODD Kc. (Fractional Mc.) Channels .1, .3, .5, .7, .9 Mc."

S-312 "ODD MC" means: "ODD whole Mc. Channels (109 Mc. or 111 Mc.) associated with the ODD Kc. (Fractional Mc.), Channels .1, .3, .5, .7, .9 Mc.


V-101 6BH6
V-102 6AK5
V-103A 1/2 6EA8
V-104 6BJ6
V-105 6BJ6
T-101
T-103
T-104
T-105
CR-102 CD6487
I-101 NO.53
I-102 NO.53
V-201 7551
V-202 7551
V-203 8106
V-204 6AR8
V-205 7587
V-103B 1/2 6EA8
V-106 6CW4
CR-101 1N459
V-301 6BH6
V-302 6CB6
V-303 6CB6
V-304 6BJ6
T-301
T-302
T-303
CR-301 CD6487
CR-303 1N457
V-305B 1/2 7898
Q-301 2N3391
V-305A 1/2 7898
V-306 6CW4
XT-301 THRU XT-310
XT-101 THRU XT-119
XT-120 THRU XT-139
150 TRANS.
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM. AUDIO
P-101
BRN
GRAY
GR
YEL
WH/GRN
VIOLET
WH/OR
BLK
RED
WH/BLK
A+ TO
A+ IN
SPEAKER GND
P-301
BLUE
BLACK
GREEN
GRAY
WH/BLUE
S-311
EVEN MC.
S-312
ODD MC.
S-305
NAV MC GLIDE SLOPE TUNING
S-309
NAV. MC GLIDE SLOPE AND LOC. ACTIVATE
MC SHAFT
NAV. KC ODD EVEN
S-313
KC SHAFT
* SEE NOTE 9
13.75
27.5
13.75

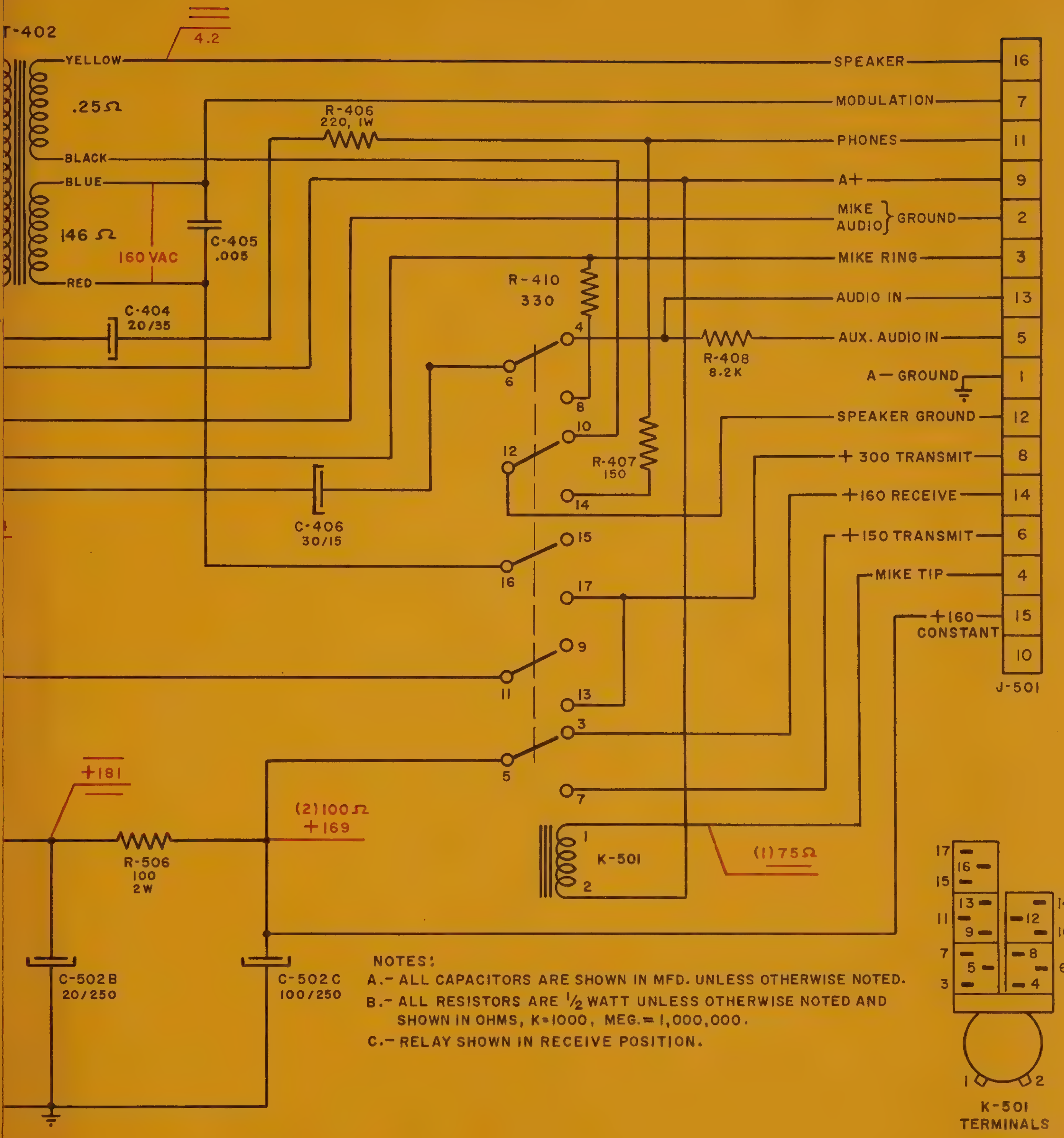
NOTES:

A.- ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
B.- ALL INDUCTORS ARE SHOWN IN MICRO-HENRIES UNLESS OTHERWISE NOTED.
C.- ALL RESISTORS ARE SHOWN IN ONE-HALF WATT UNLESS OTHERWISE NOTED.
D.- "K" DENOTES ONE THOUSAND. "M" DENOTES ONE MILLION.

NOTES:-

1. ALL RECEIVER VOLTAGES MEASURED WITH VOLUME CONTROLS FULL CCW, SQUELCH CONTROL FULL CW, NO SIGNAL INPUT AND 13.75 V.DC APPLIED TO UNIT.
2. ALL TRANSMITTER VOLTAGES MEASURED WITH TRANSMITTER KEYED AND 13.75 V.DC APPLIED TO UNIT.
3. ALL RESISTANCES MEASURED TO CHASSIS (GND.) UNLESS OTHERWISE NOTED.
4. MEASURED TO TERMINAL 14 OF P-101.
5. MEASURED TO TERMINAL 6 OF P-101.
6. MEASURED TO TERMINAL 15 OF P-101.
7. MEASURED TO TERMINAL 8 OF P-101.
8. MEASURED TO TERMINAL 7 OF P-101.
9. TERMINALS 4,5,6 AND 7 ARE LOCATED ON THE 8 TERMINAL TIE LUG STRIP MOUNTED BENEATH THE VOLUME CONTROLS. VIEWED FROM FRONT, TERMINALS ARE NUMBERED FROM RIGHT TO LEFT.
10. VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ±20% CAN BE EXPECTED.
11. MEASURED THRU A 1 MEG. OHM RESISTOR.
12. MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10MC) VOLTMETER.
13. VOLTAGE SHOWN ABOVE LINE. EXAMPLE $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$

Figure 11d.
SCHEMATIC, *narco* Mark-12, PANEL UNIT
For CN89-G and CNP89-G.


T-402
4.2
YELLOW
.25Ω
BLACK
BLUE
146 Ω
160 VAC
RED
C-405
.005
R-406
220, 1W
C-404
20/35
R-410
330
4
6
8
10
12
R-407
150
14
C-406
30/15
15
16
17
9
11
13
3
5
7
R-408
8.2K
+181
(2) 100Ω
+169
R-506
100
2W
K-501
1
2
(1) 75Ω
C-502 B
20/250
C-502 C
100/250
SPEAKER
16
MODULATION
7
PHONES
11
A+
9
MIKE
AUDIO
GROUND
2
MIKE RING
3
AUDIO IN
13
AUX. AUDIO IN
5
A — GROUND
1
SPEAKER GROUND
12
+ 300 TRANSMIT
8
+160 RECEIVE
14
+150 TRANSMIT
6
MIKE TIP
4
+160
CONSTANT
15
10
J-501
17
16
15
13
11
9
7
5
3
14
12
10
8
6
4
1
2
K-501
TERMINALS

NOTES:

A.– ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.– ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.

C.– RELAY SHOWN IN RECEIVE POSITION.

NNECTED.
ERATION
O POWER
VM OR
OSCILLOSCOPE
METER OR

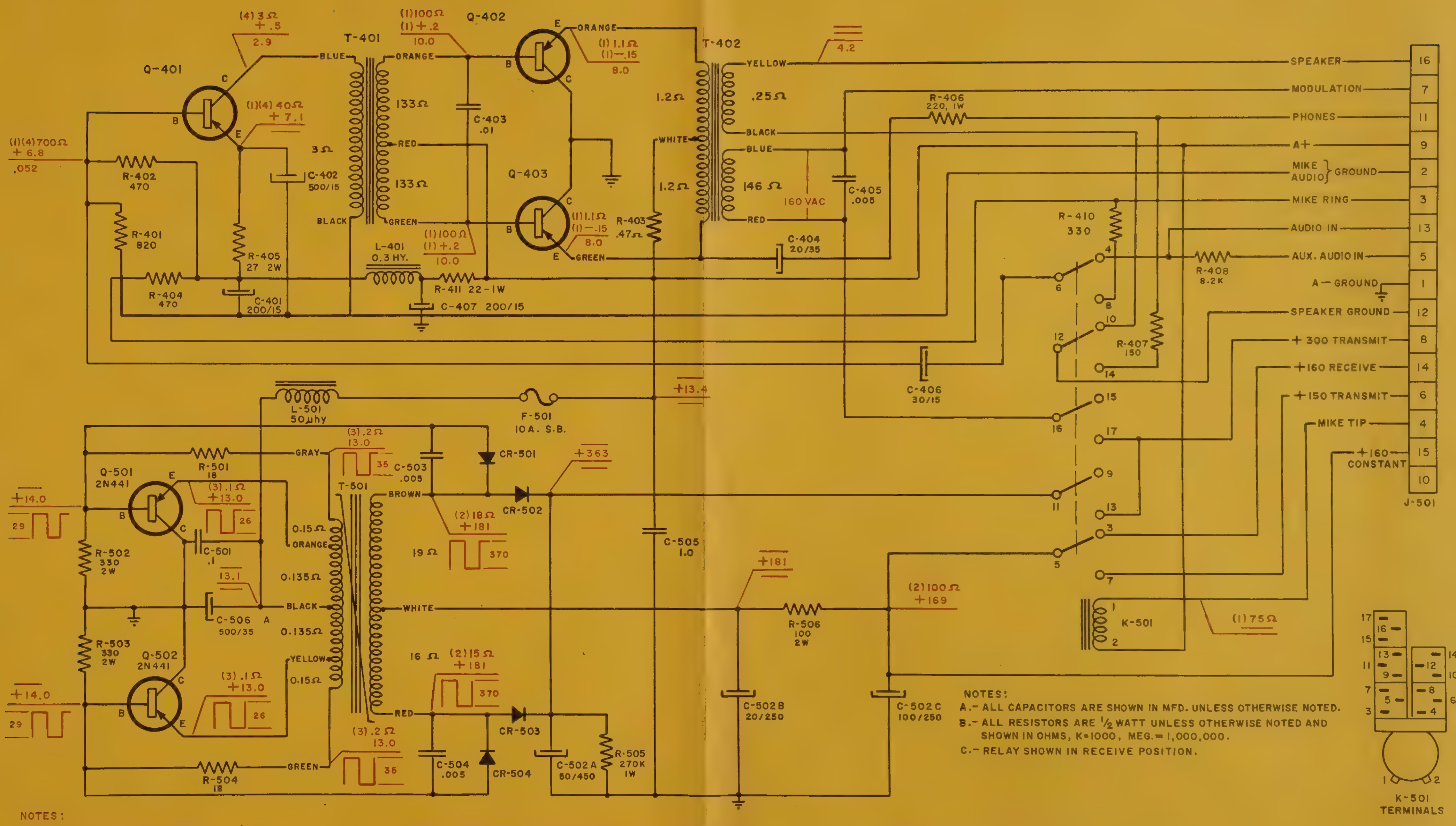
TEST DATA LINE

RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Figure 12b.
SCHEMATIC, MODULATOR POWER UNIT, T-12MP-12,
for *narco* Mark-12 operation on 12 Volts.
CNPA89-C & D


Q-401
Q-402
Q-403
T-401
T-402
BLUE
ORANGE
RED
GREEN
BLACK
YELLOW
WHITE
R-401 820
R-402 470
R-404 470
R-405 27 2W
C-401 200/15
C-402 500/15
C-403 .01
C-404 20/35
C-405 .005
L-401 0.3 HY.
R-411 22-1W
C-407 200/15
R-403 .47Ω
R-406 220, 1W
R-410 330
R-407 150
R-408 8.2K
C-406 30/15
160 VAC
(1)(4) 700Ω
+ 6.8
.052
(4) 3Ω
+ .5
2.9
(1)(4) 40Ω
+ 7.1
(1) 100Ω
(1) + .2
10.0
(1) 1.1Ω
(1) −.15
8.0
3Ω
133Ω
1.2Ω
.25Ω
146Ω
4.2
+13.4
SPEAKER 16
MODULATION 7
PHONES 11
A+ 9
MIKE AUDIO GROUND 2
MIKE RING 3
AUDIO IN 13
AUX. AUDIO IN 5
A− GROUND 1
SPEAKER GROUND 12
+ 300 TRANSMIT 8
+160 RECEIVE 14
+150 TRANSMIT 6
MIKE TIP 4
+160 CONSTANT 15
10
J-501
L-501 50μhy
F-501 10A. S.B.
Q-501 2N441
Q-502 2N441
R-501 18
R-502 330 2W
R-503 330 2W
R-504 18
C-501 .1
C-506 500/35
A
T-501
GRAY
BROWN
0.15Ω
0.135Ω
CR-501
CR-502
CR-503
CR-504
C-503 .005
C-504 .005
C-505 1.0
C-502A 50/450
C-502B 20/250
C-502C 100/250
R-505 270K 1W
R-506 100 2W
K-501
(1) 75Ω
+14.0
29
(3) .1Ω
+13.0
26
13.1
(3) .2Ω
13.0
35
(2) 18Ω
+181
370
19Ω
16Ω
(2) 15Ω
+363
+181
(2) 100Ω
+169
K-501 TERMINALS

NOTES:

A.– ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.– ALL RESISTORS ARE $1/2$ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.=1,000,000.

C.– RELAY SHOWN IN RECEIVE POSITION.

NOTES:

(1) - MEASURED WITH RESPECT TO A +, PIN-9.

(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.

(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.

(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READING TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS OF AUDIO OUT, WITH NORMAL 13.75 V. INTO POWER CABLE AT MARK-12. (AUDIO FREQUENCY 1000 CYCLES)

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE

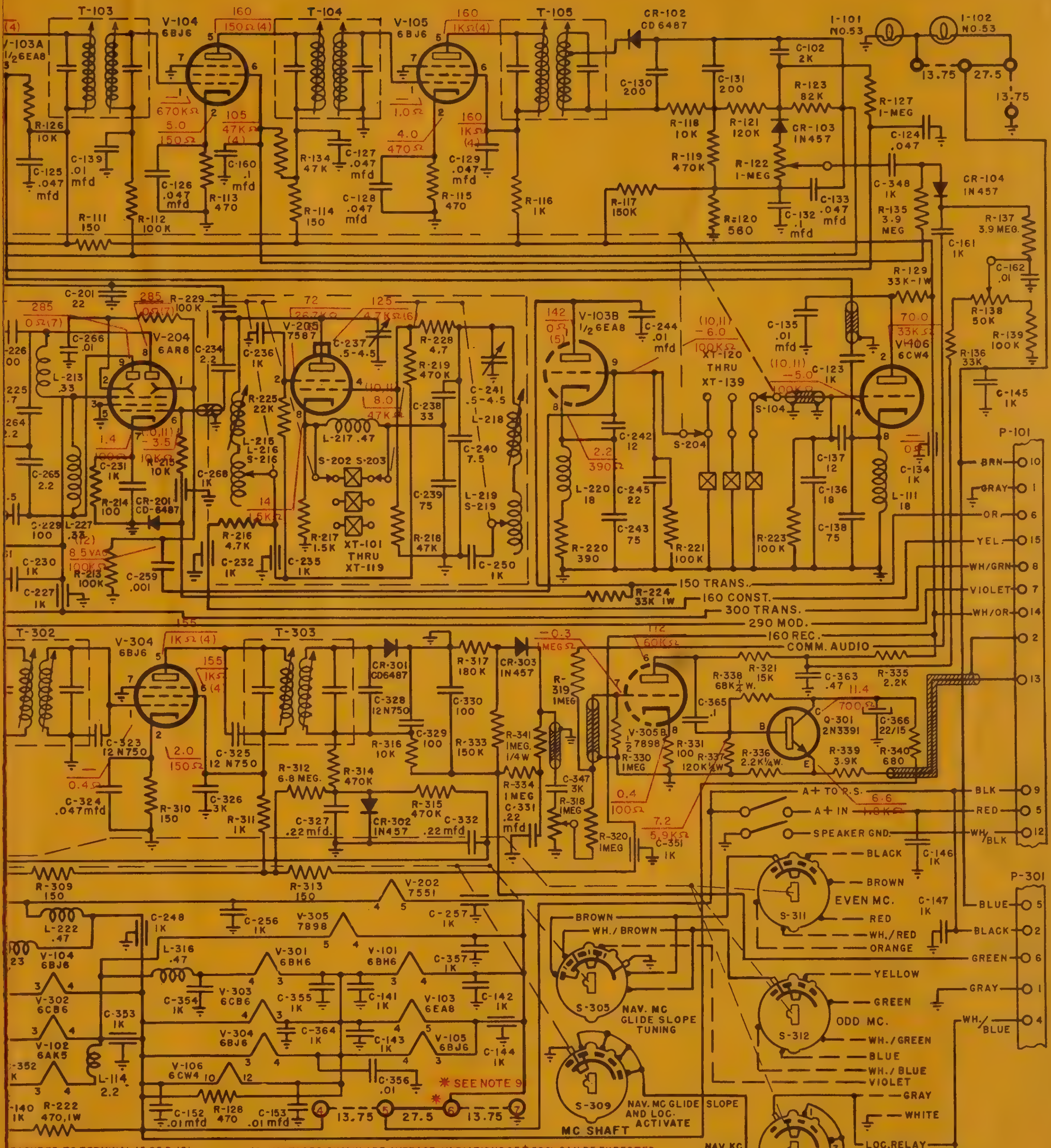
RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Figure 12b.
SCHEMATIC, MODULATOR POWER UNIT, T-12MP-12,
for *narco* Mark-12 operation on 12 Volts.
CNPA89-C & D

Ref. T-02178-L 12-14-64 ECN-4443


T-103
V-104 6BJ6
T-104
V-105 6BJ6
T-105
CR-102 CD6487
I-101 NO.53
I-102 NO.53
13.75
27.5
V-103A 1/2 6EA8
V-204 6AR8
V-205 7587
V-103B 1/2 6EA8
V-106 6CW4
XT-120 THRU XT-139
XT-101 THRU XT-119
S-202 S-203
S-204
S-104
P-101
BRN
GRAY
OR
YEL
WH/GRN
VIOLET
WH/OR
BLK
RED
WH/BLK
150 TRANS.
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM. AUDIO
T-302
V-304 6BJ6
T-303
CR-301 CD6487
CR-303 IN457
CR-302 IN457
V-305B 1/2 7898
Q-301 2N3391
A+ TO P.S.
A+ IN
SPEAKER GND.
P-301
BLUE
BLACK
GREEN
GRAY
WH/BLUE
S-311 EVEN MC.
S-305 NAV. MC GLIDE SLOPE TUNING
S-312 ODD MC.
S-309 NAV. MC GLIDE SLOPE AND LOC. ACTIVATE
MC SHAFT
S-313 NAV. KC ODD EVEN
KC SHAFT
LOC. RELAY
V-202 7551
V-305 7898
V-301 6BH6
V-101 6BH6
V-104 6BJ6
V-302 6CB6
V-303 6CB6
V-103 6EA8
V-102 6AK5
V-304 6BJ6
V-105 6BJ6
V-106 6CW4
* SEE NOTE 9
13.75
27.5
13.75

EASURED TO TERMINAL 15 OF P-101.
EASURED TO TERMINAL 8 OF P-101.
EASURED TO TERMINAL 7 OF P-101.
ERMINALS 4,5,6 AND 7 ARE LOCATED N THE 8 TERMINAL TIE LUG STRIP OUNTED BENEATH THE VOLUME CONROLS. VIEWED FROM FRONT, TERMNALS ARE NUMBERED FROM RIGHT TO LEFT.

10. VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ± 20% CAN BE EXPECTED.
11. MEASURED THRU A 1 MEG. OHM RESISTOR.
12. MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10MC) VOLTMETER.
13. VOLTAGE SHOWN ABOVE LINE. EXAMPLE VOLTAGE / RESISTANCE

Figure 11c.
SCHEMATIC, *narco* Mark -12, PANEL UNIT
For CN89-E & F and CNP89-E & F.

A. INTRODUCTION.

The Panel Unit Schematic in this supplement is concerned primarily with two changes:

1. The NAV Receiver L.F.-I.F. has been changed from 1.425 Mc to 1.125 Mc.
2. An emitter follower COM/NAV Audio output Amplifier (Q-301) has been added.

Other minor changes in both the panel and Modulator-Power Units have been made to improve the operation of current production equipments.

NOTE:

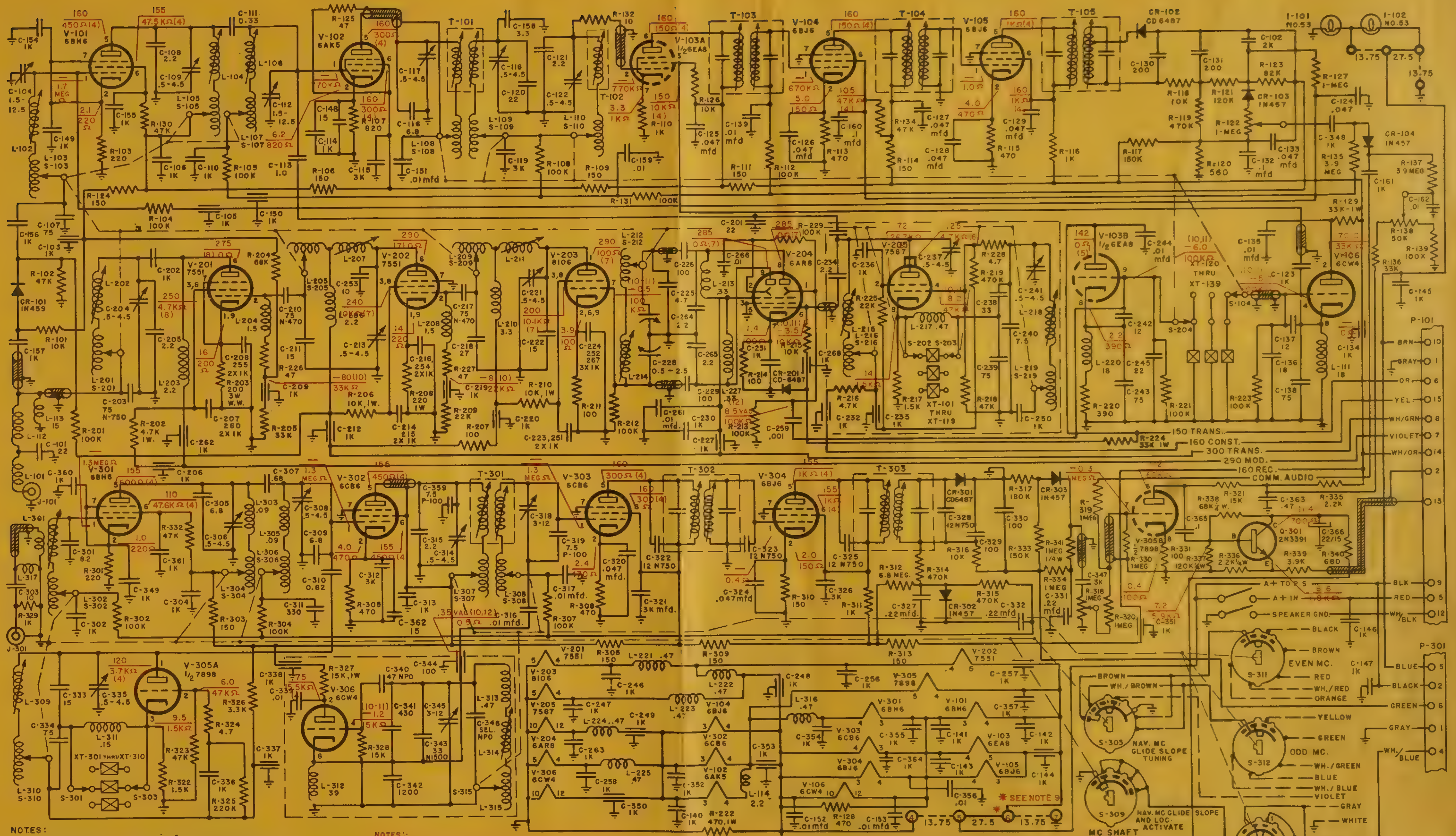
Because of a lack of space the functions of S-311 and S-312, near the lower right of Fig. 11b. on this sheet, are not fully stated.

S-311 "EVEN MC" means: "EVEN whole Mc Channels (108 Mc. or 110 Mc.) associated with the ODD Kc. (Fractional Mc.) Channels .1, .3, .5, .7, .9 Mc."

S-312 'ODD MC" means: "ODD whole Mc. Channels (109 Mc. or 111 Mc.) associated with the ODD Kc. (Fractional Mc.) Channels .1, .3, .5, .7, .9 Mc."

B. SCHEMATICS.

Figure 11c., Page 111 Extension, Panel Unit.
Figure 12b., Page 113 Extension, 12V. MP Unit.
Figure 13b., Page 115 Extension, 24V. MP Unit.


V-101 6BH6
V-102 6AK5
T-101
V-103A ½ 6EA8
T-102
T-103
V-104 6BJ6
T-104
V-105 6BJ6
T-105
CR-102 CD6487
I-101 NO.53
I-102 NO.53
V-201 7551
V-202 7551
V-203 8106
V-204 6AR8
V-205 7587
V-103B ½ 6EA8
V-106 6CW4
P-101
150 TRANS.
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM AUDIO
V-301 6BH6
V-302 6CB6
T-301
V-303 6CB6
T-302
V-304 6BJ6
T-303
V-305B ½ 7898
Q-301 2N3391
V-305A ½ 7898
V-306 6CW4
J-301
A+ TO R.S
A+ IN
SPEAKER GND
EVEN MC.
S-311
S-305
NAV. MC GLIDE SLOPE TUNING
S-312
ODD MC.
S-309
NAV. MC GLIDE SLOPE AND LOC. ACTIVATE
MC SHAFT
S-313
NAV. KC ODD EVEN
KC SHAFT
P-301
SEE NOTE 9
13.75
27.5
13.75

NOTES:
A.- ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
B.- ALL INDUCTORS ARE SHOWN IN MICRO-HENRIES UNLESS OTHERWISE NOTED.
C.- ALL RESISTORS ARE SHOWN IN ONE-HALF WATT UNLESS OTHERWISE NOTED.
D.- "K" DENOTES ONE THOUSAND. "M" DENOTES ONE MILLION.

NOTES:-
1. ALL RECEIVER VOLTAGES MEASURED WITH VOLUME CONTROLS FULL CCW, SQUELCH CONTROL FULL CW, NO SIGNAL INPUT AND 13.75 V.DC APPLIED TO UNIT.
2. ALL TRANSMITTER VOLTAGES MEASURED WITH TRANSMITTER KEYED AND 13.75 V.DC APPLIED TO UNIT.
3. ALL RESISTANCES MEASURED TO CHASSIS (GND.) UNLESS OTHERWISE NOTED.
4. MEASURED TO TERMINAL 14 OF P-101.
5. MEASURED TO TERMINAL 6 OF P-101.
6. MEASURED TO TERMINAL 15 OF P-101.
7. MEASURED TO TERMINAL 8 OF P-101.
8. MEASURED TO TERMINAL 7 OF P-101.
9. TERMINALS 4,5,6 AND 7 ARE LOCATED ON THE 8 TERMINAL TIE LUG STRIP MOUNTED BENEATH THE VOLUME CONTROLS. VIEWED FROM FRONT, TERMINALS ARE NUMBERED FROM RIGHT TO LEFT.
10. VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ±20% CAN BE EXPECTED.
11. MEASURED THRU A 1 MEG. OHM RESISTOR.
12. MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10MC) VOLTMETER.
13. VOLTAGE SHOWN ABOVE LINE. EXAMPLE $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$

Figure 11c.
SCHEMATIC, *narco* Mark -12, PANEL UNIT
For CN89-E & F and CNP89-E & F.

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS (Continued)	
C-506	21525-25	Electrolytic, 35V., 500 mf	
C-507	23085-25	Same as C-501	CNPA-89-B CNPB-89-B
C-508	23085-25	Same as C-501	CNPA-89-B CNPB-89-B
		CR, DIODES	
CR-101	75013-5	Diode, Silicon, CD12227 (Similar to 1N459)	CN-89-A,-B,-C,-D CNP-89-A,-B,-C,-D
CR-102	75019-1	Diode, Silicon, 1N914	CN-89-A, CNP-89-A CN-89-B CNP-89-B Early Production
CR-102	75019-2	Diode, Silicon, CD6487	CN-89-A, CNP-89-A CN-89-B, CNP-89-B Later Production
CR-103	75013-4	Diode, Silicon, CD12226 (Similar to 1N457)	CN-89-A,-B,-C,-D CNP-89-A,-B,-C,-D
CR-104	74013-4	Same as CR-103	CN-89-B,-C,-D CNP-89-B,-C,-D
CR-201	75019-2	Same as CR-102	Later Production
CR-301	75019-1	Same as CR-102	NAV RCVR
CR-302	75013-4	Same as CR-103	NAV RCVR
CR-303	75013-4	Same as CR-103	NAV RCVR
CR-501	75204-5	Diode, Silicon, 500 PIV	MOD-PWR Unit
CR-502	75204-5	Same as CR-501	MOD-PWR Unit
CR-503	75204-5	Same as CR-501	MOD-PWR Unit
CR-504	75204-5	Same as CR-501	MOD-PWR Unit
CR-505	75204-5	Same as CR-501	MOD-PWR Unit
CR-506	75204-5	Same as CR-501	MOD-PWR Unit
		F, FUSES	
F-501	66504-12	Fuse, 10A, Slow-Acting Type	12V. MOD-PWR Unit
F-501	66504-10	Fuse, 6-1/4A, Slow-Acting Type	24V. MOD-PWR Unit
		I, LAMPS	
I-101		Lamp No. 53 Red	Panel Illumination
I-102		Lamp, Same as I-101	Panel Illumination
		J, JACKS (CONNECTORS)	
J-101	41110-2	Connector, Chassis, Female	Com. Ant., Panel Unit
J-301	41143-1	Connector, Chassis, Female	Nav. Ant., Panel Unit
J-501	41181-4	Connector, 16 Pin	Power, MP Unit
		K, RELAYS	
K-501	65126-20	Relay, 5 Form C Contacts	T-R Transfer MOD-PWR Unit
		L, INDUCTORS	
L-101	11135-9	Choke	RF Antenna Filter
L-102	11273-26	Coil, Ant. Com. Rec.	
L-103	61378-101	Step Inductor	
L-104	11412-123	Coil, RF Plate, Com.	
L-105	61378-101	Same as L-103	
L-106	11412-129	Coil, Mixer, Comm.	
L-107	61378-101	Same as L-103	
L-108	61406-1	Step Inductor	HF IF COM
L-109	61406-1	Same as L-108	
L-110	61406-1	Same as L-108	
L-111	11138-22	Choke, RF, 18 microhenries, ± 10%	
L-112	11135-9	Same as L-101	
L-113	11138-19	Choke, RF, 15 microhenries, ± 10%, Insulated	
L-114	11138-9	Choke, RF, 2.2 microhenries	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		L, INDUCTORS (CONTINUED)	
L-201	61378-101	Same as L-103	
L-202	11627-1	Coil, Final Tank	
L-203	11138-9	Same as L-114	
L-204	11138-8	Choke, RF, 1.5 microhenry, ±20%	
L-205	61378-101	Same as L-103	
L-206	11138-9	Same as L-203	
L-207	11412-133	Coil, Second Buffer	
L-208	11138-8	Same as L-204	
L-209	61378-101	Same as L-103	
L-210	11138-11	Choke, RF, 3.3 microhenries, ±10%	
L-211	11412-134	Coil, First Buffer	
L-212	61378-101	Same as L-103	
L-213	11138-4	Choke, RF, 0.33 microhenry, ±20%	
L-214	11412-135	Coil, Mixer	
L-215	11412-132	Coil, Doubler	
L-216	61393-101	Step Inductor Doubler	
L-217	11138-5	Choke, RF, 0.47 microhenry, ±10%	
L-218	11412-112	Coil, HFO	
L-219	61393-101	Same as L-216	
L-220	11138-22	Same as L-111	
L-221	11138-5	Same as L-217	
L-222	11138-5	Same as L-217	
L-223	11138-5	Same as L-217	
L-224	11138-5	Same as L-217	
L-225	11138-5	Same as L-217	CN-89-C,-D CNP-89-C,-D
→ L-226	11138-5	Same as L-217	CN-89-C CNP-89-C
→ L-226		Not Used	CN-89-D and later, CNP-89-D and later.
L-227	11138-4	Same as L-213	
L-301	11273-22	Coil, RF	
L-302	61386-1	Step Inductor	
L-303	11138-27	Choke, RF, 0.09 microhenry, ±10%	
L-304	61386-1	Same as L-302	
L-305	11138-27	Same as L-303	
L-306	61386-1	Same as L-302	
L-307	61407-1	Step Inductor, HF IF	
L-308	61407-1	Same as L-307	
L-309	11412-131	Coil, HFO	
L-310	61386-1	Same as L-302	
L-311	11138-2	Choke, RF, 0.15 microhenry, ±20%	
L-312	11359-20	Choke, RF, 39 microhenries, ±10%	
L-313	11138-28	Choke, RF, 0.49 µh., ±5%	CN-89-A,-B CNP-89-A,-B
L-313	11138-5	Choke, RF, insulated, 0.47 µh, ±20%	CN-89-C,-D CNP-89-C,-D
L-314	11273-21	Coil, LFO	
L-315	61384-1	Step Inductor, LFO	
L-316	11138-5	Same as L-217	
L-317	11135-9	Same as L-101	
L-401	11814-2	Inductor, Filter	
L-501	11176-3	Choke, 50 microhenries	
		P, PLUGS (CONNECTORS)	
P-101	41181-3	Connector, 16 Pin Male	Power Circuits, Panel Unit Cable Assy.
	41182-2	Cap, Connector, for P-102 and P-501	Power Circuits, Panel Unit Cable Assy.
P-102	41271-1	Connector, 16 Pin Female	Panel to MP Unit Cable
P-301	41117-1	Connector, 6 Pin Female	Omni Circuits, Panel Unit Cable Assy.
	41130-1	Connector, Male	COM Ant.
	41237-1	Connector, Male	NAV Ant. Cable
	41237-2	Ferrule, for 41237-1	NAV Ant. Cable
P-501	41271-1	Same as P-102	Same as P-102
		Q, TRANSISTORS	
→ Q-301	75550-2	Transistor, NPN, Silicon, Planar, 2N3391	Audio to M-P Unit, CN-89-F & later, CNP-89-E & later.
Q-401	75510-2	Transistor, Audio Driver	Early Production
Q-401	75534-4	Transistor, Audio Driver	Later Production
Q-402	75510-4	Transistor,, Audio Output	24V. Mod-Pwr Unit, Early Production

→ Indicates a change or an addition

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
Q-402	75534-3	Transistor, Audio Output	24 V. Mod-Pwr Unit Later Production
Q-403	75510-4	Same as Q-402	12V. Mod-Pwr Unit Early Production
Q-403	75534-3	Same as Q-402	12V. Mod-Pwr Unit Later Production
Q-501	75504-1	Transistor, DC Power, 2N441	12V. Mod-Pwr Unit
→ Q-501	75543-3	Transistor, DC Power, Special	12V. Mod-Pwr Unit
Q-501	75505-3	Transistor, DC Power, 2N174	24 V. Mod-Pwr Unit
Q-502	75504-1	Same as Q-501	12V Mod-Pwr Unit
→ Q-502	75543-3	Same as Q-501	12V. Mod-Pwr. Unit
Q-502	75505-3	Same as Q-501	24V. Mod-Pwr. Unit
		R, RESISTORS	
R-101	31141-103	Carbon, ½ W, 10K ohms, ± 10%	
R-102	31141-473	Carbon, ½ W, 47K ohms, ± 10%	
R-103	31141-221	Carbon, ½ W, 220 ohms, ± 10%	
R-104	31141-104	Carbon, ½ W, 100K ohms, ± 10%	
R-105	31141-104	Same as R-104	
R-106	31141-151	Carbon, ½ W, 150 ohms, ± 10%	
R-107	31141-821	Carbon, ½ W, 820 ohms, ± 10%	
R-108	31141-104	Same as R-104	
R-109	31141-151	Same as R-106	
R-110	31141-102	Carbon, ½ W, 1K ohms, ± 10%	
R-111	31141-151	Same as R-106	
R-112	31141-104	Same as R-104	
R-113	31141-122	Carbon, ½ W, 1.2K ohms, ± 10%	CNP-89-A
R-113	31141-471	Carbon, ½ W, 470 ohms, ± 10%	CN-89-A, CN-89-B-C-D CNP-89-B-C-D
R-114	31141-151	Same as R-106	
R-115	31141-821	Same as R-107	CNP-89-A
R-115	31141-471	Same as R-113	CN-89-A, CN-89-B, CNP-89-B CNP-89-A
R-116	31141-102	Same as R-110	CNP-89-B,-C,-D CN-89-B,-C,-D
R-117	31141-154	Carbon, ½ W, 150K ohms, ± 10%	
R-118	31141-103	Same as R-101	
R-119	31141-474	Carbon, ½ W, 470K ohms ± 10%	
R-120	31141-102	Same as R-110	CN-89-A, CNP-89-A
R-120	31141-561	Carbon, ½ W, 560 ohms, ± 10%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-121	31141-124	Carbon, ½ W, 120 K ohms, ± 10%	
R-122	32040-1	Potentiometer, ½ W, 1 Megohm	CN-89-A, CNP-89-A Volume Control
R-122	32033-1	Potentiometer, ½ W, 1 Megohm	CN-89-B,-C,-D CNP-89-B,-C,-D Volume Control
R-123	31141-823	Carbon, ½ W, 82K ohms, ± 10%	
R-124	31141-151	Same as R-106	
R-125	31141-470	Carbon, ½ W, 47 ohms, ± 10%	
R-126	31141-103	Same as R-101	
R-127	31141-105	Carbon, ½ W, 1 Megohm, ± 10%	
R-128	31141-471	Same as R-305	
R-129	31135-333	Carbon, 1 W, 33 K ohms, ± 10%	
R-130	31141-473	Same as R-102	
R-131	31141-104	Same as R-104	
R-132	31141-100	Carbon, ½ W, 10 ohms, ± 10%	
R-133	31141-222	Carbon, ½ W, 2.2K ohms, ± 10%	CNP-89-A
R-134	31141-473	Same as R-102	CN-89-B,-C,-D CNP-89-B,-C,-D
R-135	31141-395	Carbon, ½ W, 3.9 Megohms, ± 10%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-136	31149-333	Carbon, ½ W, 33K ohms, ± 5%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-137	31141-395	Same as R-135	CN-89-B,.C,-D CNP-89-B,-C,-D
R-138	32033-1	Part of R-122 Assembly, Pot. 50K ohms	CN-89-B,-C,-D CNP-89-B,-C,-D Squelch Control
R-139	31149-104	Carbon, ½ W, 100K ohms, ± 5%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-201	31141-104	Same as R-104	
R-202	31135-472	Carbon, 1 W, 4.7K ohms, ± 10%	
R-203	31161-8	Wire-wound, 3 W, 200 ohms, ± 5%	
R-204	31141-683	Carbon, ½ W, 68K ohms, ± 10%	
R-205	31141-333	Carbon, ½ W, 33K ohms, ± 10%	

→ Indicates a change or an addition

R,RESISTORS (CONTINUED)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-206	31135-103	Carbon, 1 W, 10K ohms, ± 10%	
R-207	31141-101	Carbon, ½ W, 100 ohms, ± 10%	
R-208	31135-221	Carbon, 1 W, 220 ohms, ± 10%	
R-209	31141-223	Carbon, ½ W, 22K ohms, ± 10%	
R-210	31135-103	Same as R-206	
R-211	31141-101	Same as R-207	
R-212	31141-104	Same as R-104	
R-213	31141-104	Same as R-104	
R-214	31141-101	Same as R-207	
R-215	31141-103	Same as R-101	
R-216	31141-472	Carbon, ½ W, 4.7K ohms, ± 10%	
R-217	31141-152	Carbon, ½ W, 1.5K ohms, ± 10%	
R-218	31141-473	Same as R-102	
R-219	31141-474	Same as R-119	
R-220	31141-391	Carbon, ½ W, 390 ohms, ± 10%	
R-221	31141-104	Same as R-104	
R-222	31135-471	Carbon, 1 W, 470 ohms, ± 10%	
R-223	31141-104	Same as R-104	
R-224	31135-333	Same as R-129	CN-89-C,-D CNP-89-C,-D
R-225	31141-223	Same as R-209	
R-226	31141-470	Same as R-125	
R-227	31141-470	Same as R-125	
R-228	31141-479	Carbon, ½ W, 4.7 ohms, ± 10%	
→ R-229	31141-104	Same as R-104	CN-89-D and later, CNP-89-D and later.
R-301	31141-221	Same as R-103	
R-302	31141-104	Same as R-104	
R-303	31141-151	Same as R-106	
R-304	31141-104	Same as R-104	
R-305	31141-471	Carbon, ½ W, 470 ohms, ± 10%	
R-306	31141-151	Same as R-106	
R-307	31141-104	Same as R-104	
R-308	31141-471	Same as R-305	
R-309	31141-151	Same as R-106	
R-310	31141-141	Same as R-106	
R-311	31141-102	Same as R-110	
R-312	31141-685	Carbon, ½ W, 6.8 Megohms, ± 10%	
R-313	31141-151	Same as R-106	
R-314	31141-474	Same as R-119	
R-315	31141-474	Same as R-119	
R-316	31141-103	Same as R-101	
R-317	31141-184	Carbon, ½ W, 180K ohms, ± 10%	
R-318	32040-2	Potentiometer, ½ W, 1 Meg. ± 5%	Volume Control
R-319	31141-105	Same as R-127	
R-320	31141-105	Same as R-127	
R-321	31141-182	Carbon, ½ W, 1.8K ohms, ± 10%	
R-322	31141-152	Same as R-217	
R-323	31141-473	Same as R-102	
R-324	31141-479	Same as R-228	
R-325	31141-224	Carbon, ½ W, 220K ohms, ± 10%	
R-326	31141-332	Carbon, ½ W, 3.3K ohms, ± 10%	
R-327	31135-153	Carbon, 1 W, 15K ohms, ± 10%	
R-328	31141-153	Carbon, ½ W, 15K ohms, ± 10%	
R-329	31141-102	Same as R-110	
R-330	31141-105	Same as R-127	
R-331	31141-151	Same as R-106	
R-332	31141-473	Same as R-102	
R-333	31141-154	Same as R-117	
R-334	31141-105	Same as R-127	
→ R-335	31141-222	Carbon, 2.2KΩ ± 10% 1/2W	CN-89-F and later. CNP-89-E and later.
→ R-336	31192-222	Carbon, 2.2KΩ ± 10% 1/4W	CN-89-F and later. CNP-89-E and later.
→ R-337	31192-124	Carbon, 120KΩ ± 10% 1/4W	CN-89-F and later. CNP-89-E and later.
→ R-338	31192-683	Carbon, 68KΩ ± 10% 1/4W	CN-89-F and later. CNP-89-E and later.
→ R-339	31141-392	Carbon, 3.9KΩ ± 10% 1/2W	CN-89-F and later. CNP-89-E and later.
→ R-340	31141-681	Carbon, 680Ω ± 10% 1/2W	CN-89-F and later. CNP-89-E and later.
→ R-341	31192-105	Carbon, 1MEG, ± 10% 1/4W	CN-89-F and later. CNP-89-F and later.

→ Indicates a change or an addition

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		R, RESISTORS (CONTINUED)	
R-401	31141-821	Same as R-107	
R-402	31141-681	Carbon, ½ W, 680 ohms, ± 10%	Early Production
R-402	31141-471	Same as R-113 for CN-89A, CN-89B, CNP-89-B	Later Production
R-403	31179-1	Temp. Sensitive, 0.47 ohm, ± 10% + TC	
R-404	31141-471	Same as R-113	
R-405	31136-270	Carbon, 2W, 27 ohms, ± 10%	
R-406	31135-221	Carbon, 1 W, 220 ohms, ± 10%	12V. Unit
R-406	31135-681	Carbon, 1 W, 680 ohms, ± 10%	24V. Unit
R-407	31141-151	Same as R-106	12V. Unit
R-407	31141-221	Same as R-103	24 Volt Unit
R-408	31141-822	Carbon, ½ W, 8.2K ohms, ± 10%	
R-409	31175-11	Wirewound, 5W, 75 ohms, ± 5%	
R-410	31141-331	Carbon, ½ W, 330 ohms, ± 10%	CN-89-C,-D CNP-89-C,-D
→ R-411	31135-220	Carbon, 1W, 22 ohms, ± 10%	CNPA-89-D and later.
R-501	31141-180	Carbon, ½ W. 18 ohm, ± 10%	12V MOD-PWR Unit
R-501	31141-101	Same as R-207	24V MOD-PWR Unit
R-502	31136-331	Carbon, 2W, 330 ohm, ± 10%	12V MOD-PWR Unit
R-502	31136-102	Carbon, 2W, 1K ohms, ± 10%	24V MOD-PWR Unit
R-503	31136-331	Same as R-503	12V MOD-PWR Unit
R-503	31136-102	Same as R-502	24V MOD-PWR Unit
R-504	31141-180	Same as R-501	12V MOD-PWR Unit
R-504	31141-101	Same as R-501	24V MOD-PWR Unit
R-505	31135-274	Carbon, 1W, 270K ohms, ± 10%	
R-506	31136-101	Carbon, 2W, 100 ohms, ± 10%	
R-507	31175-11	Same as R-409	
R-508	31141-220	Carbon, ½ W, 22 ohm, ± 10%	For CN-89-A,-B CNP-89-A,-B
R-508	31141-330	Carbon, ½ W, 33 ohms, ± 10%	For CN-89-C-D CNP-89-C-D
R-509	31141-220	Same as R-508 for CN-89-A,-B	
R-510	31141-220	Same as R-508 for CN-89-A,-B	
		S, SWITCHES	
S-101	32040-1	Switch, Part of Assembly R-122	CN-89-A, CNP-89-A, +DC On-Off
S-101	32033-1	Switch, Part of Assembly R-122	CN-89-B,-C,-D CNP-89-B,-C,-D +DC On-Off
S-102	32040-1	Switch, Part of Assembly R-122	CN-89-A, CNP-89-A Speaker Ground
S-102	32033-1	Switch, Part of Assembly R-122	CN-89-B,-C,-D CNP-89-B,-C,-D Speaker Ground
S-103	61378-101	Switch, Part of L-103	COM RCVR RF Input
→ S-104	61409-101	Switch, Assembly	CN-89-A and later. CNP-89-A and later.
→ S-104	61409-101	Switch, Assembly, XTAL Sel., Kc	CN-89-B and later. CNP-89-B and later.
S-105	61378-101	Switch, Part of L-105	COM RCVR RF Output
S-106		Not Used	
S-107	61378-101	Part of L-107	COM RCVR RF Input
S-108	61406-1	Part of L-108	
S-109	61406-1	Part of L-109	
S-110	61406-1	Part of L-110	
S-201	61378-101	Part of L-201	
S-202	61395-1	Switch, XTAL, HFO	COM (Front)
S-203	61396-1	Switch, XTAL, HFO	COM (Rear)
S-204	61391-101	Switch, Part of S-104	
S-205	61378-101	Switch, Part of L-205	
S-206		Not Used	
S-207		Not Used	
S-208		Not Used	
S-209	61378-101	Switch, Part of L-209	
S-210		Not Used	
S-211		Not Used	
S-212	61378-101	Switch, Part of L-212	
S-213		Not Used	
S-214		Not Used	
S-215		Not Used	

→ Indicates a change or an addition

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION

S, SWITCHES (CONTINUED)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
S-216	61393-101	Switch, Part of L-216	
S-217		Not Used	
S-218		Not Used	
S-219	61393-101	Switch, Part of L-219	
S-220		Not Used	
S-301	61389-1	Switch, XTAL, HFO NAV.	
S-302	61386-1	Switch, Part of L-302	
S-303	61389-1	Same as S-301	
S-304	61386-1	Switch, Part of L-304	
S-305	61388-1	Switch, G/S	
S-306	61386-1	Switch, Part of L-306	
S-307	61407-1	Switch, Part of L-307	
S-308	61407-1	Switch, Part of L-308	
S-309	61385-1	Switch, G/S	
S-310	61386-1	Switch, Part of L-310	
S-311	61387-1	Switch, G/S	
S-312	61387-1	Same as S-311	
S-313	61387-1	Same as S-311	
S-314		Not Used	
S-315	61384-1	Switch, Part of L-315	

T, TRANSFORMERS

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
T-101	11816-102	Transformer, Com RCVR	HF IF Input
T-102	11817-102	Transformer, Com, RCVR	HF IF Input
T-103	11819-102	Transformer, Com. RCVR	LF IF Input & Interstage
T-104	11819-102	Same as T-103	LF IF Output
T-105	11820-102	Transformer, Com	
T-301	11818-102	Transformer, NAV	HF IF
T-302	11815-102	Transformer, NAV	LF IF Input
→ T-302	11652-102	Transformer, NAV	CN-89-E and later. CNP-89-F and later.
T-303	11822-102	Transformer, NAV	LF IF Output
→ T-303	11653-102	Transformer, NAV	CN-89-E and later. CNP-89-E and later
T-401	11821-102	Transformer, Audio Driver	12V. and 24V. Units
T-402	11821-101	Transformer, Audio Output	12V. Unit
T-402	11633-101	Transformer, Audio Output	24V. Unit
T-501	11626-1	Transformer, Power 13.2V	12V. Unit
T-501	11629-1	Transformer, Power 27.5V	24V. Unit

V, ELECTRON TUBES

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
V-101	6BH6	Tube, Electron, Pentode	COM. RCVR RF
V-102	6AK5	Tube, Electron, Pentode	COM. First Mixer
V-103	6EA8	Tube, Electron, Triode Pentode	COM. Second Mixer and COM. Trans LFO
V-104	6BJ6	Tube, Electron, Pentode	COM. First LF IF
V-105	6BJ6	Same as V-104	COM. Second LF IF
V-106	6CW4	Tube, Electron, Triode (Nuvistor)	COM. RCVR LFO
V-201	7551	Tube, Electron, Pentode	Trans. P.A.
V-202	7551	Same as V-201	Trans, Buffer
V-203	8106	Tube, Electron, Tetrode	Trans, RF Amp.
V-204	6AR8	Tube, Electron, Sheet Beam	Trans. Mixer
→ V-204	75401-1	Tube, Electron, Sheet Beam, Special 6AR8	CN-89-D and later. CNP-89-D and later.
V-205	7587	Tube, Electron, Tetrode (Nuvistor)	COM. Transceiver HFO/Doubler
V-301	6BH6	Same as V-101	NAV RF Amp.
V-302	6CB6	Tube, Electron, Pentode	NAV First Mixer
V-303	6CB6	Same as V-302	NAV Second Mixer
V-304	6BJ6	Same as V-104	NAV LF, IF
V-305	7898	Tube, Electron, Dual Triode	NAV HFO/Audio Cath. Follower
V-306	6CW4	Same as V-106	NAV LFO

XT, CRYSTALS, QUARTZ, SUBMINIATURE

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
XT-101	72007-121	63.2375 Mc, for 117 Whole Mc	COM. Transceiver
XT-102	72007-122	63.7375 Mc, for 118 Whole Mc	COM. Transceiver
XT-103	72007-123	64.2375 Mc. for 119 Whole Mc	COM. Transceiver
XT-104	72007-124	64.7375 Mc. for 120 Whole Mc	COM. Transceiver
XT-105	72007-125	65.2375 Mc. for 121 Whole Mc	COM. Transceiver

→ Indicates a change or an addition

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		XT, CRYSTALS, QUARTZ, SUBMINIATURE (CON'T)	
XT-106	72007-126	65.7375 Mc, for 122 Whole Mc	COM. Transceiver
XT-107	72007-127	66.2375 Mc. for 123 Whole Mc	COM. Transceiver
XT-108	72007-128	66.7375 Mc. for 124 Whole Mc	COM. Transceiver
XT-109	72007-129	67.2375 Mc. for 125 Whole Mc	COM. Transceiver
XT-110	72007-130	67.7375 Mc, for 126 Whole Mc	COM. Transceiver
XT-111	72007-131	68.2375 Mc, for 127 Whole Mc	COM. Transceiver
XT-112	72007-132	68.7375 Mc, for 128 Whole Mc	COM. Transceiver
XT-113	72007-133	69.2375 Mc, for 129 Whole Mc	COM. Transceiver
XT-114	72007-134	69.7375 Mc, for 130 Whole Mc	COM. Transceiver
XT-115	72007-135	70.2375 Mc, for 131 Whole Mc	COM. Transceiver
XT-116	72007-136	70.7375 Mc, for 132 Whole Mc	COM. Transceiver
XT-117	72007-137	71.2375 Mc, for 133 Whole Mc	COM. Transceiver
XT-118	72007-138	71.7375 Mc, for 134 Whole Mc	COM. Transceiver
XT-119	72007-139	72.2375 Mc, for 135 Whole Mc	COM. Transceiver
XT-120	72007-140	9.475 Mc, for .00 Fractional Mc	COM. Transceiver
XT-121	72007-141	9.425 Mc, for .05 Fractional Mc	COM. Transceiver
XT-122	72007-142	9.375 Mc, for .10 Fractional Mc	COM. Transceiver
XT-123	72007-143	9.325 Mc, for .15 Fractional Mc	COM. Transceiver
XT-124	72007-144	9.275 Mc, for .20 Fractional Mc	COM. Transceiver
XT-125	72007-145	9.225 Mc, for .25 Fractional Mc	COM. Transceiver
XT-126	72007-146	9.175 Mc, for .30 Fractional Mc	COM. Transceiver
XT-127	72007-147	9.125 Mc, for .35 Fractional Mc	COM. Transceiver
XT-128	72007-148	9.075 Mc, for .40 Fractional Mc	COM. Transceiver
XT-129	72007-149	9.025 Mc, for .45 Fractional Mc	COM. Transceiver
XT-130	72007-150	8.975 Mc, for .50 Fractional Mc	COM. Transceiver
XT-131	72007-151	8.925 Mc, for .55 Fractional Mc	COM. Transceiver
XT-132	72007-152	8.875 Mc, for .60 Fractional Mc	COM. Transceiver
XT-133	72007-153	8.825 Mc, for .65 Fractional Mc	COM. Transceiver
XT-134	72007-154	8.775 Mc, for .70 Fractional Mc	COM. Transceiver
XT-135	72007-155	8.725 Mc, for .75 Fractional Mc	COM. Transceiver
XT-136	72007-156	8.675 Mc, for .80 Fractional Mc	COM. Transceiver
XT-137	72007-157	8.625 Mc, for .85 Fractional Mc	COM. Transceiver
XT-138	72007-158	8.575 Mc, for .90 Fractional Mc	COM. Transceiver
XT-139	72007-159	8.525 Mc, for .95 Fractional Mc	COM. Transceiver
XT-140	72007-160	96.550 Mc, for 108 Whole Mc	NAV Receiver
XT-141	72007-161	97.550 Mc, for 109 Whole Mc	NAV Receiver
XT-142	72007-162	98.550 Mc, for 110 Whole Mc	NAV Receiver
XT-143	72007-163	99.550 Mc, for 111 Whole Mc	NAV Receiver
XT-144	72007-164	100.550 Mc, for 112 Whole Mc	NAV Receiver
XT-145	72007-165	101.550 Mc, for 113 Whole Mc	NAV Receiver
XT-146	72007-166	102.550 Mc, for 114 Whole Mc	NAV Receiver
XT-147	72007-167	103.550 Mc, for 115 Whole Mc	NAV Receiver
XT-148	72007-168	104-550 Mc, for 116 Whole Mc	NAV Receiver
XT-149	72007-169	105.550 Mc, for 117 Whole Mc	NAV Receiver
	EL-2051	KiT, Crystals, 90 to 360 Ch. Conversion	For COM Transceiver
		MISCELLANEOUS (No Symbol)	
None	41147-3	Socket, Pilot Light, One Insulated Terminal	For I-101, Panel Lamp
None	41225-2	Socket, Pilot Light, Two Insulated Terminals	For I-102, Panel Lamp
None	42015-5	Base, Tube Shield	V-203
	42033-5	Tube Socket, 7 Pin	All 7 pin min. tubes
None	42034-3	Tube Socket, 9 Pin	V-103
None	42034-6	Tube Socket, 9 Pin	V-305
None	42051-1	Tube Shield, Telescoping	V-103,204,305
None	42051-2	Tube Shield, Telescoping, Black	V-202
None	42060-4	Tube Socket, 9 Pin, Recessed	V-201,202,203,204

MISCELLANEOUS (No Symbol) (CON'T)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
None	42061-1	Socket, Nuvistor	All Nuvistor Tubes
None	42064-1	Socket, Transistor	MOD-PWR Unit, All Transistors
None	52085-101	Mounting Base	For T12MP12 or T24MP12
None	54451-1	Crystal Holder	COM Mc
None	54514-1	Spring, Grounding	Panel Unit
None	54855-1	Spring, Plate, Cap	Nuvistor
None	55020-2	Insulator, Transistor	For Q-401
None	55520-1	Crystal Holder	NAV. Mc
None	55766-1	Bushing, Knob	NAV. Mc.
None	56404-2	Mask	Panel Unit
None	56409-1	Cover, Top Osc.	NAV. Receiver
None	56410-1	Cover, Bottom Osc	NAV. Receiver
None	56414-101	Case Assembly	Panel Unit
None	56425-1	Cover, Top Osc.	COM.
None	56426-1	Cover, Bottom Osc.	COM.
None	56438-1	Cover, Dust	MOD-PWR Unit, Two required
None	56443-101	Panel Trim	Panel Unit
None	56446-1	Cover, Amp	COM. R.F. Output
None	61377-1	Detent, Adjustable	NAV. Kc
None	61401-1	Detent, Roller	COM. Kc
None	61402-1	Detent, Spring	COM. Kc
None	61404-101	Assembly, Detent Roller	COM- Kc
None	66507-1	Fuse Holder	MOD-PWR Unit
None	81312-1	Washer, Curved Spring	Case Fastener
None	81330-3	Washer, Shoulder	For Mod-Pwr Unit, Q-401
None	81621-2	Bushing, Knob	NAV. Kc
None	81622-3	Clip, Tube Pin Type	For Mod-Pwr Unit, Q-401,Q-402, Q-4
None	81677-11	Nut, Special, Hex	Ground Contact Support
None	84067-3	Stud, Southco (Wing)	Case Fastener
None	84069-1	Receptacle, Southco	Case Fastener
None	84071-1	Hairpin Retainer	Case Fastener
None	84071-2	Cotter, Hair Pin	Panel Unit, Nav. Mc Assy.
None	88111-102	Assembly, Dial	COM. Kc
None	88111-105	Assembly Dial	NAV. Kc
None	88129-2	Knob	Volume Control
None	88132-101	Assembly, Knob	COM. Mc
None	88145-101	Assembly, Knob	NAV. Mc
None	88146-3	Knob	COM. Kc
None	88146-4	Knob	NAV. Kc
None	88148-2	Knob	Squelch Control
None	90617-2	Cable only, two branches, no Connectors	For CN-89 Chassis
None	90618-96	Cable, Mod-Pwr and Accessory, 8' Long	Interconnections
None	90618-190	Cable, Mod-Pwr and Accessory, 16' Long	Interconnections
None	EL-2053	Cable, Glide Slope Switching	Interconnections

narco MARK-12 VHF Transceiver

with NAVIGATION RECEIVER and T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL

SUPPLEMENT No. 3

FOR PANEL UNITS:

CN89-E & F.
CNP89-E & F.

FOR MODULATOR-POWER UNITS:

CNPA89-C & D.
CNPB89-C & D.

NOTE

This supplement is concerned primarily with two changes:

1. The NAV Receiver L.F.-I.F. has been changed from 1.425 Mc to 1.125 Mc.
2. An emitter follower COM/NAV Audio Output Amplifier (Q-301) has been added.

Other minor changes in both the Panel and Modulator-Power Units have been made to improve the operation of current production equipments.

CONTENTS

4-D. NAV Receiver Description, page 93.
5-F. NAV Receiver Alignment, page 95.
6-C. BLOCK DIAGRAM, page 97.
7-B. LIST of PARTS, page 99.
8-B. SCHEMATICS, page 111.

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4-D. NAVIGATION RECEIVER CN89-E and LATER.

A double conversion superheterodyne circuit is employed in the navigation receiver of the Mark-12. The desired signal enters the receiver at the navigation receiver antenna connector, J-301. The signal is applied to the first of three tuned RF circuits. These circuits are tuned in steps of one megacycle by the use of gang tuned variable inductors. The RF signal is amplified by V-301 (6BH6) and applied through a capacitively coupled, double tuned circuit to the control grid of the first mixer, V-302.

The high frequency oscillator (HFO), V-305, is a crystal stabilized grounded grid oscillator. Its frequency range, using fifth overtone crystals, is 96.55 Mc to 105.55 Mc in one megacycle steps. Fundamental oscillator energy is injected through C-310 to the control grid of the first mixer, V-302.

The high frequency IF (first IF) is produced by selecting the difference frequency betwen the incoming RF signal and the HFO injection energy. This difference frequency selection is accomplished by a tuned circuit containing T-301. The tuning of T-301 is done in 100 kilocycle steps by gang switched step inductors. The HF IF is tuned over the range of 11.45 Mc to 12.35 Mc. The output of the HF IF is applied to the control grid of the second mixer, V-303.

The low frequency oscillator (LFO) is a Colpitts oscillator operating in the range from 10.325 Mc to 11.225 Mc. It is inductively tuned, by the step inductor L-315, in 100 kilocycle steps. The output of this oscillator is injected to the control grid of the second mixer, V-303, through C-316 and the secondary circuit of T-301.

The low frequency IF (second IF) is produced by selecting the difference frequency between the output of the HF IF and the LFO injection energy. This selection is done by T-302, which is the first of two 1.125 Mc IF transformers. T-302 and T-303 are overcoupled to give an adequate bandwidth. The signal from T-302 is applied to the control grid of V-304. It is amplified by V-304 and passed through T-303 to CR-301, which is a silicon diode detector.

The omni output is applied from the diode load directly to the omni converter input. The peak limiting noise limiter, CR-303, is a silicon diode. The output of the noise limiter is the input to the audio volume control, R-318. The output of the audio volume control is applied through R-320 and C-347 to the control grid of the cathode follower V-305B. The plate output of V-305B in turn goes to the base input of the emitter follower Q-301. The output of Q-301 then goes to the high level audio circuits in the Modulator-Power Unit.

The delayed AVC is developed by detector current flow through R-317, R-333, and R-316 and is applied to the RF and IF stages with the exception of the last IF stage, V-304. The time constant of the AVC is very slow to provide accurate omni range bearings.

REFERENCE—Page 15 in original manual.

5-F. NAVIGATION RECEIVER ALIGNMENT.

Reference: Schematic Fig. 11c, page 111

5-F,1. Low Frequency IF Amplifier.

Procedure:

a. Connect AC VTVM to the junction of R-316, R-333, and C-330.

b. Remove all connections from Pin 1, V-303. Connect a 47 ohm resistor from Pin 1, V-303 to ground, and connect the signal generator to Pin 1, V-303. Set the signal generator to 1.125 Mc, 400 cps 30% modulation. Increase the signal generator output for a usable indication on the AC VTVM.

c. Set the signal generator to 1.115 Mc and tune the primary and secondary tuning slugs of T-302 and T-303 for maximum indication on the AC VTVM.

d. Set the signal generator to 1.135 Mc and tune the primary and secondary tuning slugs of T-302 and T-303 for maximum indication on the AC VTVM.

e. Repeat steps c. and d. until no further increase in AC VTVM indication is obtained and peak amplitudes are approximately equal with approximately 20 Kc peak separation. The hole depth between the two peaks should be approximately 1.0 db.

f. Figure 3a, page 96, illustrates the low frequency IF response.

g. Remove the signal generator and the 47 ohm resistor from Pin 1, V-303, and reconnect the components previously removed. Remove the AC VTVM from the junction of R-316, R-333, and C-330.

Normal Indication:

350 μv maximum input for 1.9 VAC detector output.

5-F,2. Selectivity—Low Frequency IF Bandwidth

Procedure:

a. Connect AC VTVM to the junction of R-316, R-333, and C-330.

b. Remove all connections from Pin 1, V-303. Connect a 47 ohm resistor from Pin 1, V-303 to ground, and connect the Signal Generator to Pin 1, V-303. Set the signal generator to 1.125 Mc 400 cps 30% modulation. Adjust the signal generator output to produce a usable indication on the AC VTVM.

c. Vary the signal generator frequency across the LF IF response. It will be noted that the IF response peaks approximately 10 Kc either side of 1.125 Mc, with 1.125 Mc falling at the bottom of a "hole" or "dip" in the response between the two peaks. See Figure 3a, page 96, for the low frequency IF response. Use the AC VTVM indication at this "hole" in the response, at 1.125 Mc, as the reference level to measure bandwidth.

d. With the reference level set, increase the signal generator output 6 db (2:1). Tune the signal generator frequency below 1.125 Mc until the reference level is obtained on the AC VTVM. Note this frequency. Tune the signal generator frequency above 1.125 Mc until the reference level is obtained on the AC VTVM. Note this frequency. The difference between the two noted frequencies is the total 6 db bandwidth.

e. With the reference level set, increase the signal generator output 60 db (1000:1). Tune the signal generator frequency below 1.125 Mc until the reference level is obtained on the AC VTVM. Note this frequency. Tune the signal generator frequency above 1.125 Mc until the reference level is obtained on the AC VTVM. Note this frequency. The difference between the two noted frequencies is the total 60 db bandwidth.

f. Remove the signal generator and the 47 ohm resistor from Pin 1, V-303, and reconnect the components previously removed. Remove the AC VTVM from the junction of R-316, R-333 and C-330.

Normal Indication:

6 DB— 40 Kc minimum total bandwidth
60 DB—200 Kc maximum total bandwidth

REFERENCE—Page 24 in original manual.

5-F,4. Low Frequency Oscillator.

PRIMARY METHOD

Procedure:

a. Determine that the HF IF is properly aligned.

b. Disconnect Pin 5, V-303 from T-302. Connect a 39 μhy choke from Pin 6, V-303 to Pin 5, V-303. Connect a 47 μμfd 500V capacitor from Pin 5, V-303 to the input of the frequency counter. Remove all connections from Pin 1, V-302.

c. Set L-314 to mid-range. (Tuning screw half way in.) Set C-345 to mid-range. (Slot for tuning tool horizontal with respect to the chassis.)

d. Set the fractional Mc selector to the 0.9 position. Observe the frequency indicated on the counter. Adjust L-314 for an indication of 11.225 Mc on the counter.

e. Set the fractional Mc selector to the 0.0 position. Observe the frequency indicated on the counter. Adjust C-345 for an indication of 10.325 Mc on the counter.

f. Repeat steps d. and e. until the circuit is tracked. Check the frequency of each fractional Mc position. The frequency must be within ±8 Kc of the center frequency for each position. See Table IVa., below.

g. Reconnect the components previously removed from Pin 1, V-302. Remove the counter, 47 uufd capacitor, and 39 μhy choke from Pin 5 and Pin 6 of V-103. Reconnect Pin 5, V-303 to T-302.

TABLE IVa.

OSCILLATOR FREQUENCY — LFO

NAVIGATION RECEIVER

Channel	Center Frequency (Mc)
.0	10.325
.1	10.425
.2	10.525
.3	10.625
.4	10.725
.5	10.825
.6	10.925
.7	11.025
.8	11.125
.9	11.225

ALTERNATE METHOD

Procedure:

a. Calibrate a BC-221 frequency meter to the nearest crystal check point related to the 10 Mc through 11 mc range.

b. Connect a length of insulated wire (#22 hook up wire is adequate) to the antenna post of the BC-221. Insert the other end of the wire into the plate and screen area of V-303. Take care that the wire is well away from the control grid area of V-303 or oscillator frequency pulling will be experienced.

c. Set the fractional Mc selector to the 0.9 position. Set the BC-221 to 11.225 Mc. Adjust L-314 for a zero beat from the BC-221.

d. Set the fractional Mc selector to the 0.0 position. Set the BC-221 to 10.325 Mc. Adjust C-345 for a zero beat from the BC-221.

c. Repeat steps c. and d. until the circuit is tracked. Check the frequency of each fractional Mc position. The frequency must be within ±8 Kc of the center frequency for each position.

Normal Indication:

Each fractional Mc position must be no more than ±8 Kc from its center frequency.

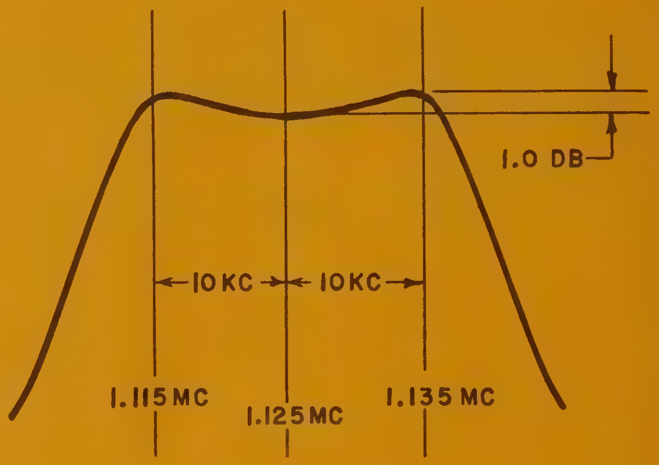
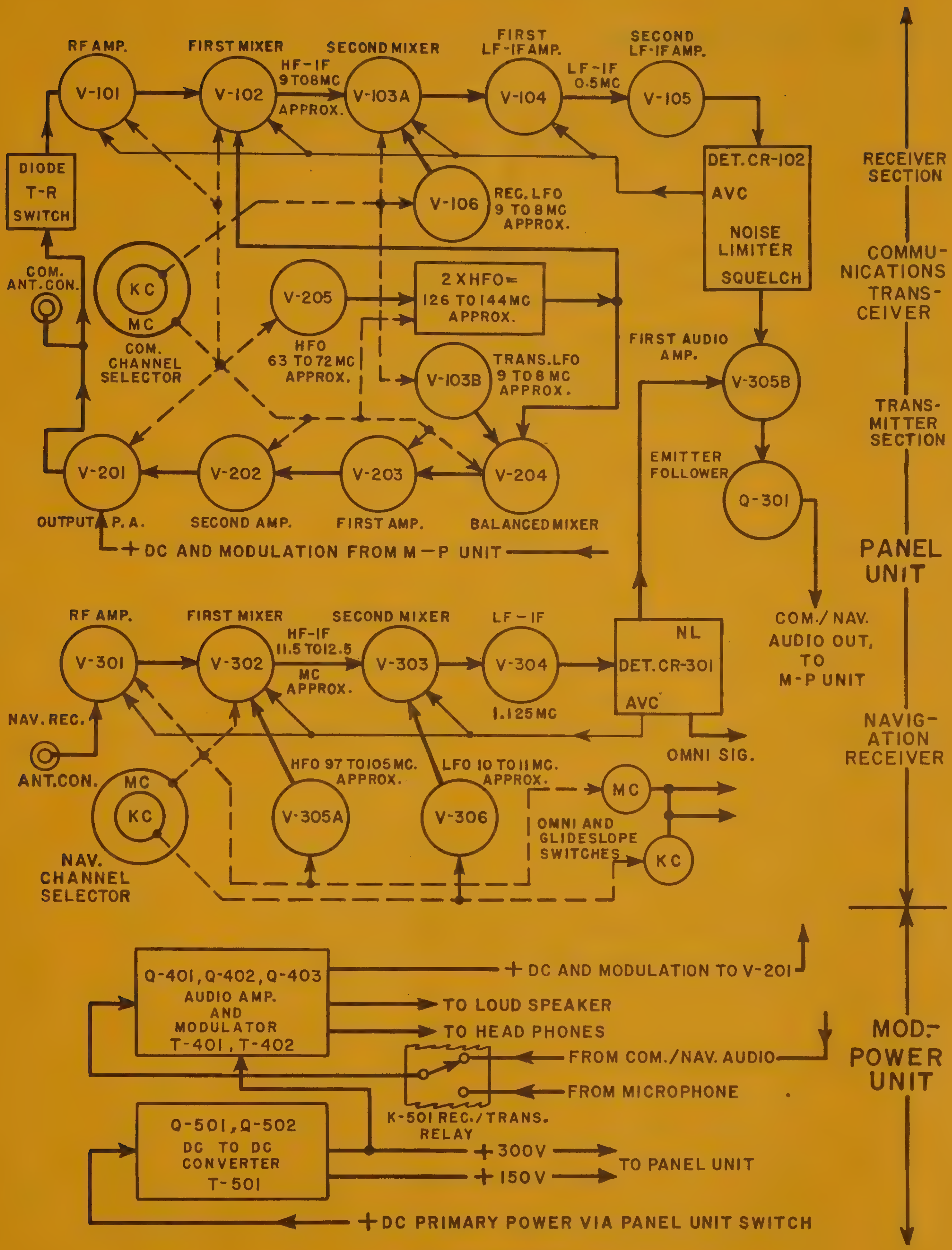


Figure 3a.
narco Mark-12 NAV. Receiver.
L.F. I.F. Response.

REFERENCES—Pages 25 and 30 in original manual.


RF AMP.
V-101
FIRST MIXER
V-102
HF-IF
9 TO 8 MC
APPROX.
SECOND MIXER
V-103A
FIRST
LF-IF AMP.
V-104
LF-IF
0.5 MC
SECOND
LF-IF AMP.
V-105
DIODE
T-R
SWITCH
DET. CR-102
AVC
NOISE
LIMITER
SQUELCH
V-106
REC. LFO
9 TO 8 MC
APPROX.
RECEIVER
SECTION
COM.
ANT. CON.
KC
MC
COM.
CHANNEL
SELECTOR
V-205
HFO
63 TO 72 MC
APPROX.
2 X HFO=
126 TO 144 MC
APPROX.
COMMU-
NICATIONS
TRANS-
CEIVER
V-103B
TRANS. LFO
9 TO 8 MC
APPROX.
FIRST AUDIO
AMP.
V-305B
TRANS-
MITTER
SECTION
V-201
V-202
V-203
V-204
EMITTER
FOLLOWER
Q-301
OUTPUT P. A.
SECOND AMP.
FIRST AMP.
BALANCED MIXER
+ DC AND MODULATION FROM M-P UNIT
PANEL
UNIT
RF AMP.
V-301
FIRST MIXER
V-302
HF-IF
11.5 TO 12.5
MC
APPROX.
SECOND MIXER
V-303
LF-IF
V-304
1.125 MC
NL
DET. CR-301
AVC
COM./NAV.
AUDIO OUT,
TO
M-P UNIT
NAV. REC.
ANT. CON.
MC
KC
NAV.
CHANNEL
SELECTOR
HFO 97 TO 105 MC.
APPROX.
V-305A
LFO 10 TO 11 MC.
APPROX.
V-306
OMNI SIG.
MC
OMNI AND
GLIDESLOPE
SWITCHES
KC
NAVIG-
ATION
RECEIVER
Q-401, Q-402, Q-403
AUDIO AMP.
AND
MODULATOR
T-401, T-402
+ DC AND MODULATION TO V-201
TO LOUD SPEAKER
TO HEAD PHONES
FROM COM./NAV. AUDIO
FROM MICROPHONE
K-501 REC./TRANS.
RELAY
MOD.-
POWER
UNIT
Q-501, Q-502
DC TO DC
CONVERTER
T-501
+300V
+150V
TO PANEL UNIT
+ DC PRIMARY POWER VIA PANEL UNIT SWITCH

BLOCK DIAGRAM
narco Mark-12 COMMUNICATIONS TRANSCEIVER

REPLACEMENT PARTS

This Supplement No. 3, Replacement Parts List is a complete integrated list for all Panel Units (CN89-A thru F and CNP89-A thru F) and all Modulator-Power Units (CNPA89-A thru D and CNPB89 A thru D).

A. INTRODUCTION.

This list of Replacement Parts contains the items that may be considered replaceable in the field. They should preferably be ordered by Symbol No., Part No., and Description.

The Replacement Parts are listed by their Symbol letter and number, alphabetically then numerically. Some items without a Symbol No., are listed numerically by Part Number in a "Miscellaneous" List following the listings by Symbol numbers. A few items without a Symbol No. may be listed with associated parts such as connectors.

The "Function or Application" column is intended to separate the description of the item from its purpose in the equipment. It may also be found useful when working with the Illustrations and Schematics.

B. LIST OF PARTS.

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS	
C-101	21201-220	Ceramic Tubular, 500V, 22 micromicrofarads, ±10%	
C-102	21291-15	Ceramic Disc, 500V, .002 microfarads, ± 10%	
C-103	21298-1	Feed-Thru, 500V, .001 microfarad, + 100% − 0%	
C-104	22019-2	Variable Plunger, 500V, 1.5 − 12.5 micromicrofarads	
C-105	21298-1	Same as C-103	COM RCVR RF Input
C-106	21291-21	Ceramic Disc., 1000V., .001 microfarad, ± 20%	
C-107	21384-750	Ceramic Tubular, 500V, 75 micromicrofarads, ± 5%	
C-108	24516-229	Ceramic Disc., 500V, 2.2 micromicrofarads, ± 0.25	
C-109	22019-1	Variable Plunger, 500V, 0.5 − 4.5 micromicrofarads	COM RCVR RF Output
C-110	21291-21	Same as C-106	
C-111	24509-338	Ceramic, 500V., .33 micromicrofarads, ± 5%	
C-112	22019-2	Same as C-104	
C-113	24502-109	Ceramic, 500V., 1.0 micromicrofarads, ± 5%	COM RCVR First Mixer Input
C-114	21291-21	Same as C-106	
C-115	21291-4	Ceramic Disc, 500V, .003 microfarad, ± 80% − 20%	
C-116	24516-689	Ceramic Disc, 500V., 6.8 micromicrofarads ± 0.5 micromicrofarads	
C-117	22019-1	Same as C-109	COM RCVR First Mixer Output
C-118	22019-1	Same as C-109	COM RCVR HF IF
C-119	21291-9	Ceramic Disc, 500V., .003 microfarad, ± 10%	
C-120	21201-220	Same as C-101	
C-121	24516-229	Same as C-108	
C-122	22019-1	Same as C-109	COM RCVR Second Mixer Input
C-123	21291-21	Same as C-106	
C-124	23085-71	Mylar, 100V., .047 microfarad, ± 10%	
C-125	23085-171	Mylar, 200V., .047 microfarad, ± 10%	
C-126	23085-71	Same as C-124	
C-127	23085-171	Same as C-125	
C-128	23085-71	Same as C-124	
C-129	23085-171	Same as C-125	
C-130	21291-11	Ceramic Disc, 500V., 200 micromicrofarads, ± 10%	
C-131	21291-11	Same as C-130	
C-132	23085-75	Mylar, 100V, 0.1 microfarad, ± 10%	
C-133	23085-71	Same as C-124	
C-134	21298-1	Same as C-103	
C-135	21291-6	Ceramic Disc, 500V., 0.01 microfarad, GMV	

C, CAPACITORS, (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
C-136	24049-180	Dipped Mica, 500V., 18 micromicrofarads, ±5%	
C-137	24049-120	Dipped Mica, 500V., 12 micromicrofarads, ±1.0 micromicrofarads	
C-138	24049-750	Dipped Mica, 500 V., 75 micromicrofarads, ±5%	
C-139	23085-113	Mylar, 200V., .01 microfarad, ±20%	
C-140	21291-21	Same as C-106	
C-141	21291-21	Same as C-106	
C-142	21291-21	Same as C-106	
C-143	21291-21	Same as C-106	
C-144	21298-1	Same as C-103	
C-145	21291-21	Same as C-106	
C-146	21291-21	Same as C-106	
C-147	21291-21	Same as C-106	
C-148	24516-150	Ceramic Disc, 15 micromicrofarads, ±10%	
C-149	21291-21	Same as C-106	
C-150	21298-1	Same as C-103	
C-151	21291-6	Same as C-135	
C-152	21291-5	Ceramic Disc, 50 V., .01 mf, +80% −30%	
C-153	21291-5	Same as C-152	
C-154	21291-21	Same as C-106	
C-155	21291-21	Same as C-106	
C-156	21291-21	Same as C-106	
C-157	21291-21	Same as C-106	
C-158	24516-339	Ceramic Disc, 500V., 3.3 micromicrofarads, ±10%	
C-159	23085-113	Same as C-139	
C-160	23085-125	Mylar, 200V, 0.1 μfd, ±20%	CN-89-B,-C,-D. CNP-89-B,-C,-D
C-161	23085-151	Mylar, Tubular, 200V, .001 mfd, ±10%	CN-89-B,-C,-D CNP-89-B,-C,-D
→ C-162	23085-113	Same as C-139	CN-89-E and later. CN-P89-F and later.
C-201	21201-220	Same as C-101	CN-89-C,-D. CNP-89-C,-D
C-202	21291-21	Same as C-106	
C-203	21384-750	Same as C-107	
C-204	22019-1	Same as C-109	XMTR PA Output
C-205	21201-229	Ceramic Tubular, 500 V, 2.2 micromicrofarads, 0.25 micromicrofarads	
C-206	21298-1	Same as C-103	
C-207	21291-21	Same as C-106	
C-208	21291-21	Same as C-106	
C-209	21298-1	Same as C-103	
C-210	21383-750	Ceramic Tub., 500V., 75 micromicrofarads, ±5%	
C-211	21201-150	Ceramic Tub., 500V., 15 mmf, ±10%	
C-212	21298-1	Same as C-103	
C-213	22019-1	Same as C-109	XMTR Buffer Output
C-214	21291-21	Same as C-106	
C-215	21291-21	Same as C-106	
C-216	21291-21	Same as C-106	
C-217	21383-750	Same as C-210	
C-218	21201-270	Ceramic Tub., 500V., 27 mmf, ±10%	
C-219	21298-1	Same as C-103	
C-220	21298-1	Same as C-103	
C-221	22019-1	Same as C-109	XMTR RF AMp. Output
C-222	21201-150	Same as C-211	
C-223	21291-21	Same as C-106	
C-224	21291-21	Same as C-106	
C-225	21201-479	Ceramic Tub., 500 V., 4.7 mmf, ±0.5 micromicrofarads	
C-226	21291-14	Ceramic Disc, 500V., 100 mmf, ±10%	
C-227	21298-1	Same as C-103	
C-228	22029-1	Split Stator Glass, 500V., 0.5 to 2.5 micromicrofarads	XMTR Mixer
C-229	21291-14	Same as C-226	
C-230	21291-21	Same as C-106	
C-231	21291-21	Same as C-106	
C-232	21298-1	Same as C-103	
C-233	24516-229	Same as C-108	
C-234	24516-229	Same as C-108	
C-235	21298-1	Same as C-103	

→ Indicates a change or an addition

C, CAPACITORS, (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
C-236	21291-21	Same as C-106	
C-237	22019-1	Same as C-109	COM TCVR HFO/Doubler Output
C-238	24049-330	Dipped Mica, 500V., 33 micromicrofarads, ±5%	
C-239	24049-750	Same as C-138	
C-240	21201-759	Ceramic Tub., 500V., 7.5 micromicrofarads, ±0.5 micromicrofarad	
C-241	22019-1	Same as C-109	COM TCVR HFO/Doubler Input
C-242	24049-120	Same as C-137	
C-243	24049-750	Same as C-138	
C-244	21291-6	Same as C-135	
C-245	24049-220	Dipped Mica, 500V., 22 micromicrofarads, ±5%	
C-246	21291-21	Same as C-106	
C-247	21291-21	Same as C-106	
C-248	21298-1	Same as C-103	
C-249	21298-1	Same as C-103	
C-250	21291-19	Ceramic Disc, 500V., 1K micromicrofarad, ±10%	
C-251	21291-21	Same as C-106	
C-252	21291-21	Same as C-106	
C-253	21201-100	Ceramic Tub., 500 V., 10 micromicrofarads, ±1.0 micromicrofarads	
C-254	21291-21	Same as C-106	
C-255	21291-21	Same as C-106	
C-256	21291-21	Same as C-106	
C-257	21298-1	Same as C-103	
C-258	21291-21	Same as C-106	
→ C-259	21291-21	Same as C-106	
C-260	21291-21	Same as C-106	
C-261	21291-6	Same as C-135	
C-262	21298-1	Same as C-103	
C-263	21291-21	Same as C-106	
C-264	24516-229	Same as C-108	
C-265	24516-229	Same as C-108	
C-266	21291-21	Same as C-106	CN-89-A,-B, CNP-89-A,-B.
C-266	21291-5	Same as C-152	CN-89-C,-D CNP-89-C,-D.
C-267	21291-21	Same as C-106	
C-268	21298-1	Same as C-103	
C-301	21201-100	Same as C-253	Early Production
C-301	21201-829	Ceramic Tub., 500V., 8.2μμf, ±0.5μμf, NPO.	Later Production
C-302	21291-21	Same as C-106	
C-303	21201-100	Same as C-253	
C-304	21291-21	Same As C-106	
C-305	24516-689	Same as C-116	
C-306	22019-1	Same as C-109	NAV RCVR RF Output
C-307	24509-688	Ceramic, 500V., 68 micromicrofarads, ±5%	
C-308	22019-1	Same as C-109	NAV RCVR First Mixer Input
C-309	24516-689	Same as C-116	
C-310	24509-828	Ceramic, 500V., .82 micromicrofarads, ±5%	
C-311	21219-18	Ceramic Disc. 500V., 330 micromicrofarads, ±10%	
C-312	21291-4	Same as C-115	
C-313	21291-21	Same as C-106	
C-314	22019-1	Same as C-109	NAV RCVR First Mixer Output
C-315	21201-229	Same as C-205	
C-316	21291-6	Same as C-135	
C-317	23085-113	Same as C-139	
C-318	22001-312	Ceramic Trimmer, 350V., 3-12 mmf, NPO.	NAV Second Mixer Input
C-319	21282-2	Ceramic Tub., 500V., 7.5 micromicrofarads, ±0.5%	
C-320	23085-71	Same as C-124	
C-321	21291-4	Same as C-115	
C-322	21207-120	Ceramic Tub., 12 micromicrofarads, ±10%, N-750	
C-323	21207-120	Same as C-322	
C-324	23085-71	Same as C-124	
C-325	21207-120	Same as C-322	

→ Indicates a change or an addition

C, CAPACITORS (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
C-326	21291-4	Same as C-115	
C-327	23085-79	Mylar, 100V., 22 microfarad, ± 10%	
C-328	21207-120	Same as C-322	
C-329	21291-14	Same as C-226	
C-330	21291-14	Same as C-226	
C-331	23085-79	Same as C-327	
C-332	23085-79	Same as C-327	
C-333	24049-150	Dipped Mica, 500 V., 15 micromicrofarads, ± 1.0 micromicrofarad	
C-334	24049-750	Same as C-327	NAV RCVR HFO Output
C-335	22019-1	Same as C-109	NAV RCVR HFO Output
C-336	21291-21	Same as C-106	
C-337	21298-1	Same as C-103	
C-338	21298-1	Same as C-103	
C-339	21291-6	Same as C-135	
C-340	21299-470	Ceramic Tub., 500V., 47 micromicrofarads, ± 10%	
C-341	24049-431	Dipped Mica, 500V., 15 micromicrofarads, ± 1.0 micromicrofarad	
C-342	24045-122	Dipped Mica, 500V., 1200 micromicrofarads	
C-343	21206-330	Ceramic Tub., 500V., 33μμf, ± 10%, N-470	CN-89-A,-B CNP-89-A,-B
C-343	21294-330	Ceramic Tub., 500V., 33μμf, ± 10%, N-1500	CN-89-C,-D CNP-89-C,-D
C-344	24517-1	Feed Thru, 500V., 100 micromicrofarads, ± 10%	
C-345	22001-312	Same as C-318	
C-346	21201-330	Ceramic Tub., 500V., 33μμf, ± 10%	
C-346	21201-Sel.	Ceramic Tub., 500V., 33 or 47 micromicrofarads, ± 10%	
C-347	21291-21	Same as C-106	
→ C-347	21291-4	Same as C-115	CN-89-F and later CNP-89-F and later
C-348	21291-21	Same as C-106	CN-89-A CNP-89-A
C-348	23085-151	Same as C-161	CN-89-B,-C,-D CNP-89-B,-C,-D
C-349	21291-21	Same as C-106	
C-350	21298-1	Same as C-103	
C-351	21298-1	Same as C-103	
C-352	21291-21	Same as C-106	
C-353	21298-1	Same as C-103	
C-354	21291-21	Same as C-106	
C-355	21291-21	Same as C-106	
C-356	21291-5	Same as C-152	
C-357	21291-21	Same as C-106	
C-358	21291-21	Same as C-106	
C-359	21282-2	Same as C-319	
C-360	21291-21	Same as C-106	
C-361	21291-21	Same as C-106	
C-362	24516-150	Same as C-148	
C-363	21291-7	Ceramic Disc, 1000V., 470μμf, ± 20%	CN-89-C,-D CNP-89-C,-D
→ C-363	23087-63	Metalized Mylar, 200V., 0.47μf, ± 20%	CN-89-F and later CNP-89-E and later
C-364	21291-21	Same as C-106	CN-89-C,-D CNP-89-C,-D
→ C-365	23085-125	Same as C-160	CN-89-F and later
→ C-366	21555-18	Solid Tantalum 15V., 22μf	CN-89-F and later CNP-89-E and later
C-401	21552-16	Electrolytic, 3V., 150 microfarads, + 150% − 10%	
→ C-401	21554-3	Electrolytic, 15V., 200 microfarads	CNPA-89-D and later CNPB-89-D and later
C-402	21552-17	Electrolytic, 15V., 500 microfarads, Min. Tol.	
C-403	23085-113	Same as C-139	
C-404	21552-3	Electrolytic, 35V., 20 mf, + 150% − 10%	
C-405	21291-22	Ceramic Disc, 500V., .005 mf, ± 10%	
C-406	21552-18	Electrolytic, 15 forward, 5 reverse, 30 mfd, + 150% − 10%	
→ C-407	21554-3	Same as C-401	CNPA-89-D and later CNPB-89-D and later
C-501	23085-25	Mylar, 100V., 0.1μf, ± 20%	
C-502	21525-23	Electrolytic, 400V., − 50 mf, 200V. − 100 mf, 200V. − 20mf	
C-503	21291-23	Ceramic Disc, 500V., .004mf, ± 10%	24 V. Operation
C-503	21291-22	Same as C-405	12 V. Operation
C-504	21291-22	Same as C-503	12 V. Operation
C-504	21291-23	Same as C-503	24 V. Operation
C-505	23085-87	Mylar, 100V., 1.0 mf, ± 10%	

→ Indicates a change or an addition

XT, CRYSTALS, QUARTZ, SUBMINIATURE (CON'T)

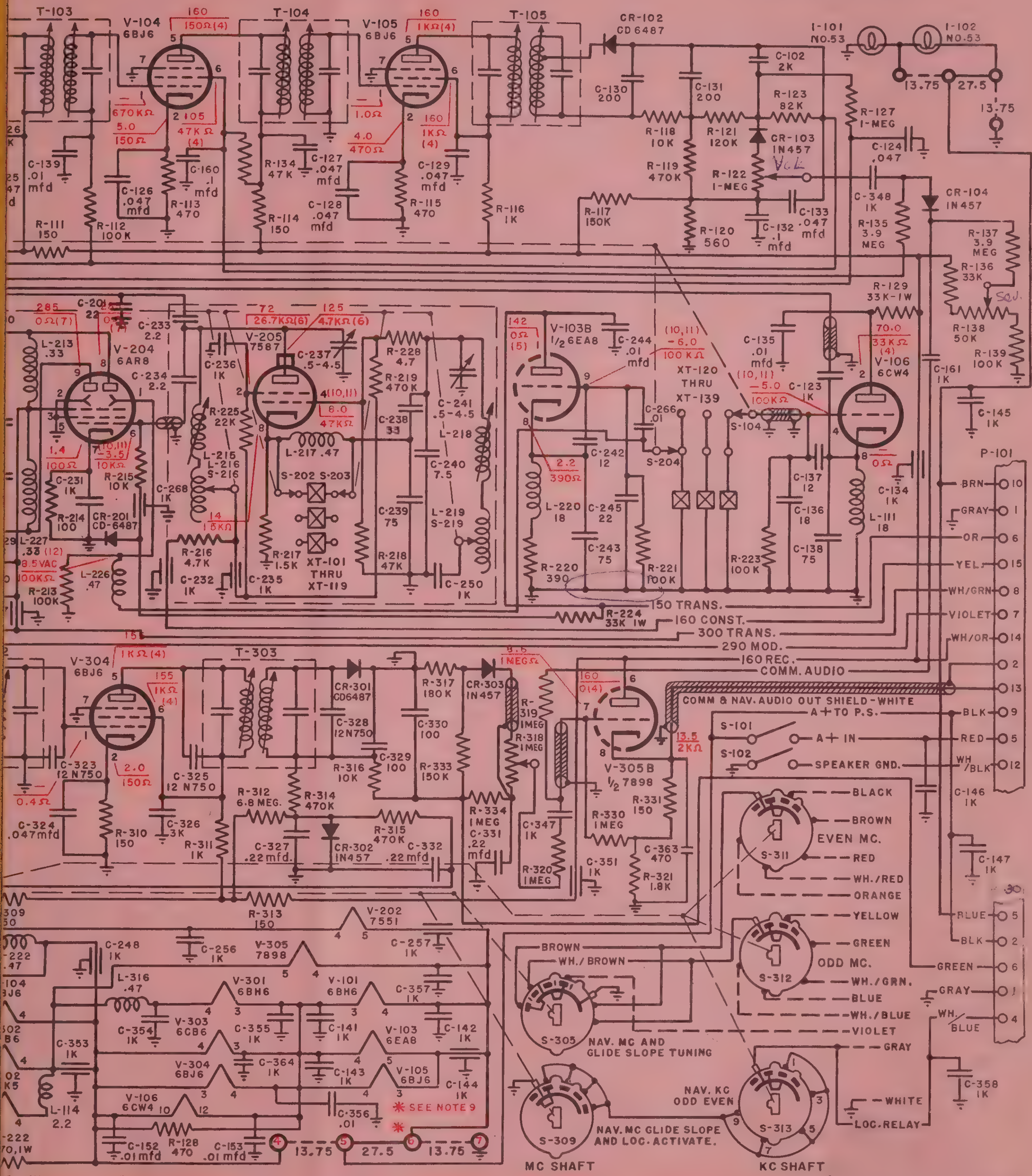
SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
XT-106	72007-126	65.7375 Mc, for 122 Whole Mc	COM. Transceiver
XT-107	72007-127	66.2375 Mc. for 123 Whole Mc	COM. Transceiver
XT-108	72007-128	66.7375 Mc. for 124 Whole Mc	COM. Transceiver
XT-109	72007-129	67.2375 Mc. for 125 Whole Mc	COM. Transceiver
XT-110	72007-130	67.7375 Mc, for 126 Whole Mc	COM. Transceiver
XT-111	72007-131	68.2375 Mc, for 127 Whole Mc	COM. Transceiver
XT-112	72007-132	68.7375 Mc, for 128 Whole Mc	COM. Transceiver
XT-113	72007-133	69.2375 Mc, for 129 Whole Mc	COM. Transceiver
XT-114	72007-134	69.7375 Mc, for 130 Whole Mc	COM. Transceiver
XT-115	72007-135	70.2375 Mc, for 131 Whole Mc	COM. Transceiver
XT-116	72007-136	70.7375 Mc, for 132 Whole Mc	COM. Transceiver
XT-117	72007-137	71.2375 Mc, for 133 Whole Mc	COM. Transceiver
XT-118	72007-138	71.7375 Mc, for 134 Whole Mc	COM. Transceiver
XT-119	72007-139	72.2375 Mc, for 135 Whole Mc	COM. Transceiver
XT-120	72007-140	9.475 Mc, for .00 Fractional Mc	COM. Transceiver
XT-121	72007-141	9.425 Mc, for .05 Fractional Mc	COM. Transceiver
XT-122	72007-142	9.375 Mc, for .10 Fractional Mc	COM. Transceiver
XT-123	72007-143	9.325 Mc, for .15 Fractional Mc	COM. Transceiver
XT-124	72007-144	9.275 Mc, for .20 Fractional Mc	COM. Transceiver
XT-125	72007-145	9.225 Mc, for .25 Fractional Mc	COM. Transceiver
XT-126	72007-146	9.175 Mc, for .30 Fractional Mc	COM. Transceiver
XT-127	72007-147	9.125 Mc, for .35 Fractional Mc	COM. Transceiver
XT-128	72007-148	9.075 Mc, for .40 Fractional Mc	COM. Transceiver
XT-129	72007-149	9.025 Mc, for .45 Fractional Mc	COM. Transceiver
XT-130	72007-150	8.975 Mc, for .50 Fractional Mc	COM. Transceiver
XT-131	72007-151	8.925 Mc, for .55 Fractional Mc	COM. Transceiver
XT-132	72007-152	8.875 Mc, for .60 Fractional Mc	COM. Transceiver
XT-133	72007-153	8.825 Mc, for .65 Fractional Mc	COM. Transceiver
XT-134	72007-154	8.775 Mc, for .70 Fractional Mc	COM. Transceiver
XT-135	72007-155	8.725 Mc, for .75 Fractional Mc	COM. Transceiver
XT-136	72007-156	8.675 Mc, for .80 Fractional Mc	COM. Transceiver
XT-137	72007-157	8.625 Mc, for .85 Fractional Mc	COM. Transceiver
XT-138	72007-158	8.575 Mc, for .90 Fractional Mc	COM. Transceiver
XT-139	72007-159	8.525 Mc, for .95 Fractional Mc	COM. Transceiver
XT-140	72007-160	96.550 Mc, for 108 Whole Mc	NAV Receiver
XT-141	72007-161	97.550 Mc, for 109 Whole Mc	NAV Receiver
XT-142	72007-162	98.550 Mc, for 110 Whole Mc	NAV Receiver
XT-143	72007-163	99.550 Mc, for 111 Whole Mc	NAV Receiver
XT-144	72007-164	100.550 Mc, for 112 Whole Mc	NAV Receiver
XT-145	72007-165	101.550 Mc, for 113 Whole Mc	NAV Receiver
XT-146	72007-166	102.550 Mc, for 114 Whole Mc	NAV Receiver
XT-147	72007-167	103.550 Mc, for 115 Whole Mc	NAV Receiver
XT-148	72007-168	104.550 Mc, for 116 Whole Mc	NAV Receiver
XT-149	72007-169	105.550 Mc, for 117 Whole Mc	NAV Receiver
	EL-2051	KiT, Crystals, 90 to 360 Ch. Conversion	For COM Transceiver

MISCELLANEOUS (No Symbol)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
None	41147-3	Socket, Pilot Light, One Insulated Terminal	For I-101, Panel Lamp
None	41225-2	Socket, Pilot Light, Two Insulated Terminals	For I-102, Panel Lamp
None	42015-5	Base, Tube Shield	V-203
	42033-5	Tube Socket, 7 Pin	All 7 pin min. tubes
None	42034-3	Tube Socket, 9 Pin	V-103
None	42034-6	Tube Socket, 9 Pin	V-305
None	42051-1	Tube Shield, Telescoping	V-103,204,305
None	42051-2	Tube Shield, Telescoping, Black	V-202
None	42060-4	Tube Socket, 9 Pin, Recessed	V-201,202,203,204

MISCELLANEOUS (No Symbol) (CON'T)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
None	42061-1	Socket, Nuvistor	All Nuvistor Tubes
None	42064-1	Socket, Transistor	MOD-PWR Unit, All Transistors
None	52085-101	Mounting Base	For T12MP12 or T24MP12
None	54451-1	Crystal Holder	COM Mc
None	54514-1	Spring, Grounding	Panel Unit
None	54855-1	Spring, Plate, Cap	Nuvistor
None	55020-2	Insulator, Transistor	For Q-401
None	55520-1	Crystal Holder	NAV. Mc
None	55766-1	Bushing, Knob	NAV. Mc.
None	56404-2	Mask	Panel Unit
None	56409-1	Cover, Top Osc.	NAV. Receiver
None	56410-1	Cover, Bottom Osc.	NAV. Receiver
None	56414-101	Case Assembly	Panel Unit
None	56425-1	Cover, Top Osc.	COM.
None	56426-1	Cover, Bottom Osc.	COM.
None	56438-1	Cover, Dust	MOD-PWR Unit, Two required
None	56443-101	Panel Trim	Panel Unit
None	56446-1	Cover, Amp	COM. R.F. Output
None	61377-1	Detent, Adjustable	NAV. Kc
None	61401-1	Detent, Roller	COM. Kc
None	61402-1	Detent, Spring	COM. Kc
None	61404-101	Assembly, Detent Roller	COM- Kc
None	66507-1	Fuse Holder	MOD-PWR Unit
None	81312-1	Washer, Curved Spring	Case Fastener
None	81330-3	Washer, Shoulder	For Mod-Pwr Unit, Q-401
None	81621-2	Bushing, Knob	NAV. Kc
None	81622-3	Clip, Tube Pin Type	For Mod-Pwr Unit, Q-401,Q-402, Q-40
None	81677-11	Nut, Special, Hex	Ground Contact Support
None	84067-3	Stud, Southco (Wing)	Case Fastener
None	84069-1	Receptacle, Southco	Case Fastener
None	84071-1	Hairpin Retainer	Case Fastener
None	84071-2	Cotter, Hair Pin	Panel Unit, Nav. Mc Assy.
None	88111-102	Assembly, Dial	COM. Kc
None	88111-105	Assembly Dial	NAV. Kc
None	88129-2	Knob	Volume Control
None	88132-101	Assembly, Knob	COM. Mc
None	88145-101	Assembly, Knob	NAV. Mc
None	88146-3	Knob	COM. Kc
None	88146-4	Knob	NAV. Kc
None	88148-2	Knob	Squelch Control
None	90617-2	Cable only, two branches, no Connectors	For CN-89 Chassis
None	90618-96	Cable, Mod-Pwr and Accessory, 8' Long	Interconnections
None	90618-190	Cable, Mod-Pwr and Accessory, 16' Long	Interconnections
None	EL-2053	Cable, Glide Slope Switching	Interconnections


T-103
V-104
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T-104
V-105
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T-105
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C-130
200
C-131
200
R-123
82K
R-127
1-MEG
R-118
10K
R-121
120K
CR-103
IN457
C-124
.047
R-119
470K
R-122
1-MEG
R-117
150K
R-120
560
C-132
.1 mfd
C-133
.047 mfd
C-348
1K
R-135
3.9 MEG
CR-104
IN457
R-137
3.9 MEG
R-136
33K
R-129
33K-1W
R-138
50K
R-139
100K
C-139
.01 mfd
C-126
.047 mfd
R-113
470
C-160
.1 mfd
R-111
150
R-112
100K
R-134
47K
C-127
.047 mfd
R-114
150
C-128
.047 mfd
C-129
.047 mfd
R-115
470
R-116
1K
V-204
6AR8
L-213
.33
C-201
22
C-233
2.2
C-234
2.2
V-205
7587
C-236
1K
C-237
.5-4.5
R-225
22K
L-215
L-216
S-216
R-228
4.7
R-219
470K
C-238
33
C-241
.5-4.5
L-218
L-217 .47
S-202 S-203
C-240
7.5
C-239
75
L-219
S-219
R-218
47K
C-250
1K
R-217
1.5K
XT-101
THRU
XT-119
C-235
1K
C-231
1K
R-215
10K
R-214
100
CR-201
CD-6487
C-268
1K
R-216
4.7K
C-232
1K
L-227
.33
R-213
100K
L-226
.47
V-103B
1/2 6EA8
C-244
.01 mfd
XT-120
THRU
XT-139
C-266
.01
S-204
S-104
C-242
12
C-245
22
L-220
18
C-243
75
R-220
390
R-221
100K
R-224
33K 1W
C-135
.01 mfd
C-123
1K
V-106
6CW4
C-161
1K
C-145
1K
C-137
12
C-136
18
C-138
75
R-223
100K
C-134
1K
L-111
18
P-101
150 TRANS.
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM. AUDIO
COMM & NAV. AUDIO OUT SHIELD-WHITE
A+ TO P.S.
A+ IN
SPEAKER GND.
S-101
S-102
BRN
GRAY
OR
YEL
WH/GRN
VIOLET
WH/OR
BLK
RED
WH/BLK
BLUE
GREEN
WH/BLUE
V-304
6BJ6
T-303
CR-301
CD6487
C-328
12N750
R-317
180K
CR-303
IN457
C-330
100
R-319
1MEG
R-318
1MEG
C-329
100
R-316
10K
R-333
150K
C-323
12 N750
C-325
12 N750
R-312
6.8 MEG.
R-314
470K
R-315
470K
C-324
.047mfd
R-310
150
C-326
3K
R-311
1K
C-327
.22 mfd.
CR-302
IN457
C-332
.22 mfd
R-334
1MEG
C-331
.22 mfd
V-305B
1/2 7898
R-331
150
R-330
1MEG
C-347
1K
R-320
1MEG
C-351
1K
C-363
470
R-321
1.8K
C-146
1K
C-147
1K
R-309
R-313
150
V-202
7551
C-248
1K
C-256
1K
V-305
7898
C-257
1K
L-222
.47
L-316
.47
V-301
6BH6
V-101
6BH6
C-357
1K
C-354
1K
V-303
6CB6
C-355
1K
C-141
1K
V-103
6EA8
C-142
1K
C-353
1K
V-304
6BJ6
C-364
1K
C-143
1K
V-105
6BJ6
C-144
1K
V-106
6CW4
L-114
2.2
C-356
.01
✱ SEE NOTE 9
C-152
.01mfd
R-128
470
C-153
.01 mfd
13.75
27.5
13.75
BLACK
BROWN
EVEN MC.
S-311
RED
WH./RED
ORANGE
YELLOW
GREEN
ODD MC.
S-312
WH./GRN.
BLUE
WH./BLUE
VIOLET
GRAY
BROWN
WH./BROWN
S-305
NAV. MC AND GLIDE SLOPE TUNING
S-309
NAV. MC GLIDE SLOPE AND LOC. ACTIVATE.
MC SHAFT
NAV. KC ODD EVEN
S-313
KC SHAFT
C-358
1K
WHITE
LOC. RELAY

6.– MEASURED TO TERMINAL 15 OF P-101.
7.– MEASURED TO TERMINAL 8 OF P-101.
8.– MEASURED TO TERMINAL 7 OF P-101.
9.– TERMINALS 4, 5, 6, AND 7 ARE LOCATED ON THE 8 TERMINAL TIE LUG STRIP MOUNTED BENEATH THE VOLUME CONTROLS. VIEWED FROM FRONT, TERMINALS ARE NUMBERED FROM RIGHT TO LEFT.

10.– VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ± 20 % CAN BE EXPECTED.
11.– MEASURED THRU A 1 MEG. OHM RESISTOR.
12.– MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10 MC) VOLTMETER.
13.– VOLTAGE SHOWN ABOVE LINE – EXAMPLE $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$

Figure 11b.

SCHEMATIC, *narco* Mark-12. PANEL UNIT
For CN89-C & D and CNP89-C & D

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		MISCELLANEOUS (No Symbol) (CON'T)	
None	42061-1	Socket, Nuvistor	All Nuvistor Tubes
None	42064-1	Socket, Transistor	MOD-PWR Unit, All Transistors
None	52085-101	Mounting Base	For T12MP12 or T24MP12
None	54451-1	Crystal Holder	COM Mc
None	54514-1	Spring, Grounding	Panel Unit
None	54855-1	Spring, Plate, Cap	Nuvistor
None	55020-2	Insulator, Transistor	For Q-401
None	55520-1	Crystal Holder	NAV. Mc
None	55766-1	Bushing, Knob	NAV. Mc.
None	56404-2	Mask	Panel Unit
None	56409-1	Cover, Top Osc.	NAV. Receiver
None	56410-1	Cover, Bottom Osc.	NAV. Receiver
None	56414-101	Case Assembly	Panel Unit
None	56425-1	Cover, Top Osc.	COM.
None	56426-1	Cover, Bottom Osc.	COM.
None	56438-1	Cover, Dust	MOD-PWR Unit, Two required
None	56443-101	Panel Trim	Panel Unit
None	56446-1	Cover, Amp	COM. R.F. Output
None	61377-1	Detent, Adjustable	NAV. Kc
None	61401-1	Detent, Roller	COM. Kc
None	61402-1	Detent, Spring	COM. Kc
None	61404-101	Assembly, Detent Roller	COM- Kc
None	66507-1	Fuse Holder	MOD-PWR Unit
None	81312-1	Washer, Curved Spring	Case Fastener
None	81330-3	Washer, Shoulder	For Mod-Pwr Unit, Q-401
None	81621-2	Bushing, Knob	NAV. Kc
None	81622-3	Clip, Tube Pin Type	For Mod-Pwr Unit, Q-401,Q-402, Q-4
None	81677-11	Nut, Special, Hex	Ground Contact Support
None	84067-3	Stud, Southco (Wing)	Case Fastener
None	84069-1	Receptacle, Southco	Case Fastener
None	84071-1	Hairpin Retainer	Case Fastener
None	84071-2	Cotter, Hair Pin	Panel Unit, Nav. Mc Assy.
None	88111-102	Assembly, Dial	COM. Kc
None	88111-105	Assembly Dial	NAV. Kc
None	88129-2	Knob	Volume Control
None	88132-101	Assembly, Knob	COM. Mc
None	88145-101	Assembly, Knob	NAV. Mc
None	88146-3	Knob	COM. Kc
None	88146-4	Knob	NAV. Kc
None	88148-2	Knob	Squelch Control
None	90617-2	Cable only, two branches, no Connectors	For CN-89 Chassis
None	90618-96	Cable, Mod-Pwr and Accessory, 8' Long	Interconnections
None	90618-190	Cable, Mod-Pwr and Accessory, 16' Long	Interconnections
None	EL-2053	Cable, Glide Slope Switching	Interconnections

COMMENTS.

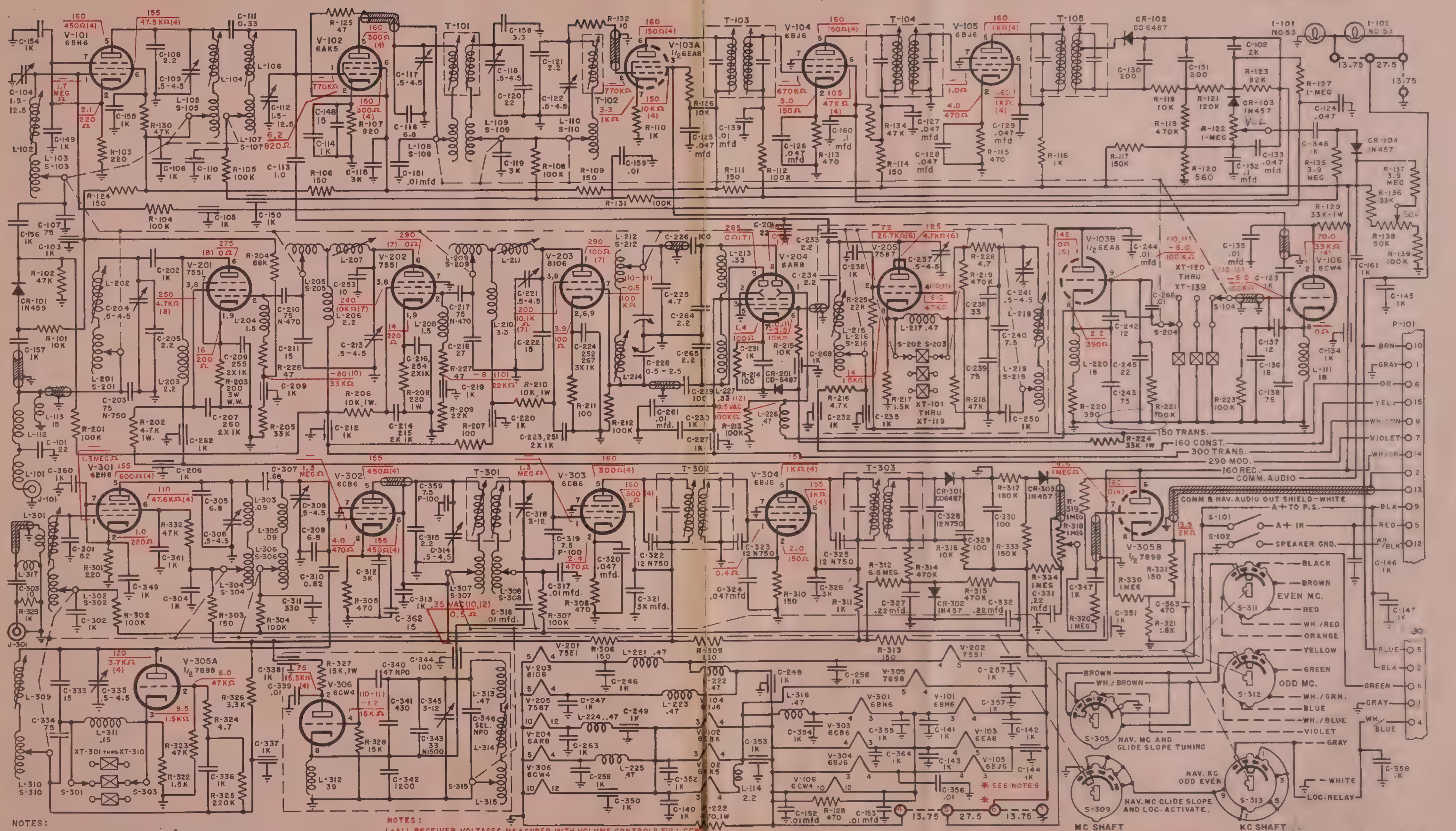
The revised schematics in this Supplement No. 2, represent differences of a minor nature, based on developments during successive production runs and on field experience.

NOTE:

Because of a lack of space the functions of S-311 and S-312, near the lower right of Fig. 11b. on this sheet, are not fully stated.

S-311 "EVEN MC" means: "EVEN whole Mc Channels (108 Mc. or 110 Mc.) associated with the ODD Kc. (Fractional Mc.) Channels .1, .3, .5, .7, .9 Mc."

S-312 "ODD MC" means: "ODD whole Mc. Channels (109 Mc. or 111 Mc.) associated with the ODD Kc. (Fractional Mc.) Channels .1, .3, .5, .7, .9 Mc."


V-101 6BH6
V-102 6AK5
T-101
T-102
V-103A 1/2 6EA8
T-103
V-104 6BJ6
T-104
V-105 6BJ6
T-105
CR-102 CD 6487
I-101 NO.53
I-102 NO.53
13.75
27.5
V-201 7551
V-202 7551
V-203 8106
V-204 6AR8
V-205 7587
V-103B 1/2 6EA8
XT-120 THRU XT-139
V-106 6CW4
XT-101 THRU XT-119
P-101
BRN
GRAY
OR
YEL
WH./GRN
VIOLET
WH./OR
BLK
RED
WH./BLK
BLUE
GREEN
150 TRANS.
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM. AUDIO
COMM & NAV. AUDIO OUT SHIELD-WHITE
A+ TO P.S.
A+ IN
SPEAKER GND.
V-301 6BH6
V-302 6CB6
T-301
V-303 6CB6
T-302
V-304 6BJ6
T-303
CR-301 CD6487
CR-303 IN457
V-305B 1/2 7898
J-101
J-301
V-305A 1/2 7898
V-306 6CW4
XT-301 THRU XT-310
S-301
S-303
S-315
BLACK
BROWN
EVEN MC.
RED
WH./RED
ORANGE
YELLOW
S-311
ODD MC.
WH./GRN.
WH./BLUE
VIOLET
GRAY
S-312
S-305
NAV. MC AND GLIDE SLOPE TUNING
NAV. KC ODD EVEN
S-309
S-313
NAV. MC GLIDE SLOPE AND LOC. ACTIVATE.
WHITE
LOC. RELAY
MC SHAFT
KC SHAFT
SEE NOTE 9

NOTES:

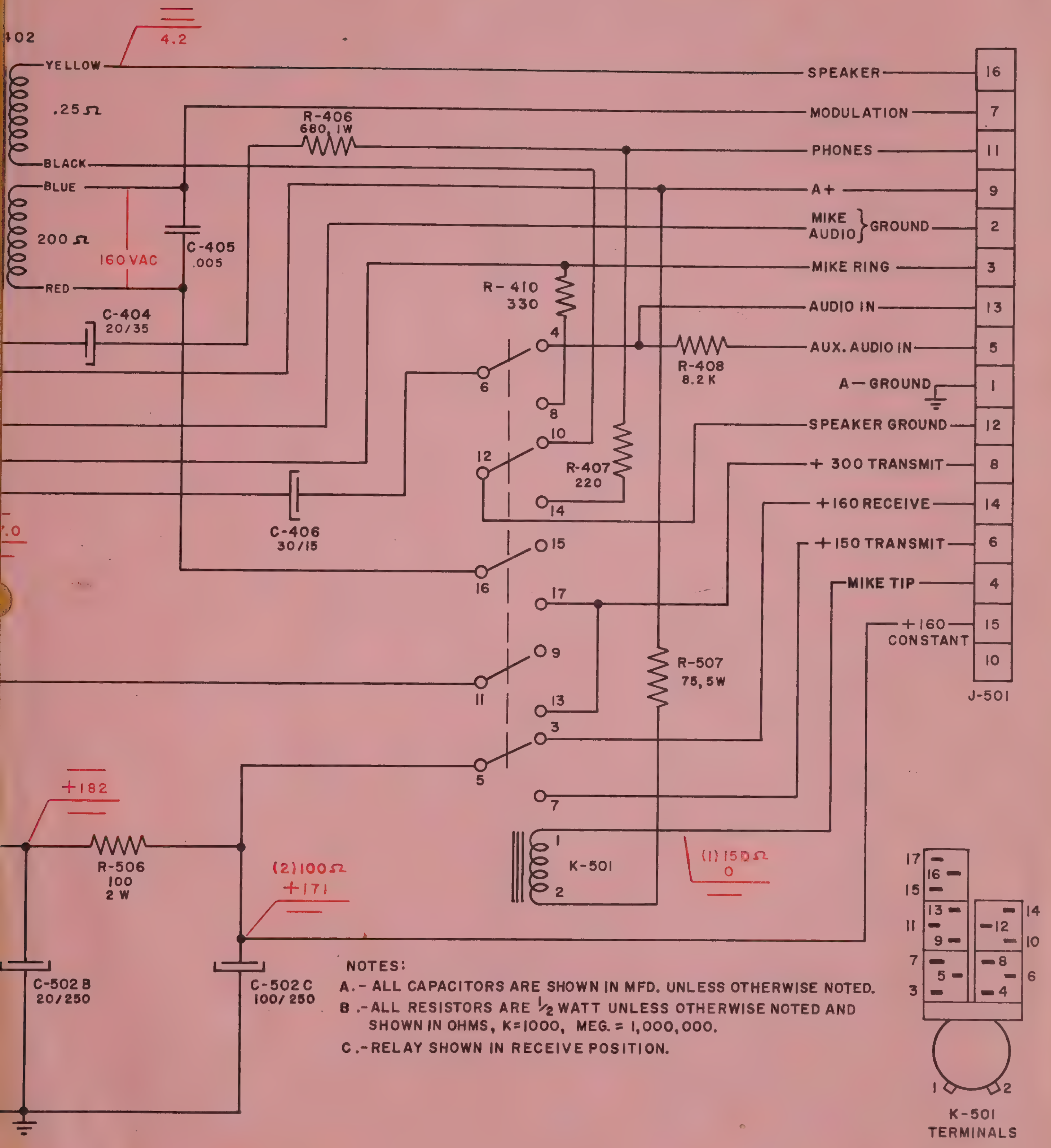
A.- ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
B.- ALL INDUCTORS ARE SHOWN IN MICRO-HENRIES UNLESS OTHERWISE NOTED.
C.- ALL RESISTORS ARE SHOWN IN ONE-HALF WATT UNLESS OTHERWISE NOTED.
D.- "K" DENOTES ONE THOUSAND. "M" DENOTES ONE MILLION.

NOTES:

1.- ALL RECEIVER VOLTAGES MEASURED WITH VOLUME CONTROLS FULL CCW SQUELCH CONTROL FULL CW, NO SIGNAL INPUT AND 13.75 V. DC APPLIED TO UNIT.
2.- ALL TRANSMITTER VOLTAGES MEASURED WITH TRANSMITTER KEYED AND 13.75 V DC APPLIED TO UNIT.
3.- ALL RESISTANCES MEASURED TO CHASSIS (GND.) UNLESS OTHERWISE NOTED.
4.- MEASURED TO TERMINAL 14 OF P-101.
5.- MEASURED TO TERMINAL 6 OF P-101.
6.- MEASURED TO TERMINAL 15 OF P-101.
7.- MEASURED TO TERMINAL 8 OF P-101.
8.- MEASURED TO TERMINAL 7 OF P-101.
9.- TERMINALS 4, 5, 6, AND 7 ARE LOCATED ON THE 8 TERMINAL TIE LUG STRIP MOUNTED BENEATH THE VOLUME CONTROLS. VIEWED FROM FRONT, TERMINALS ARE NUMBERED FROM RIGHT TO LEFT.
10.- VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ± 20 % CAN BE EXPECTED.
11.- MEASURED THRU A 1 MEG. OHM RESISTOR.
12.- MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10 MC) VOLTMETER.
13.- VOLTAGE SHOWN ABOVE LINE - EXAMPLE $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$

Figure 11b.
SCHEMATIC, *narco* Mark-12. PANEL UNIT
For CN89-C & D and CNP89-C & D

T-02177A-Rev. BB 5-13-64 ECN-4317


402
YELLOW
4.2
.25 Ω
BLACK
BLUE
200 Ω
160 VAC
RED
C-405
.005
R-406
680, 1W
C-404
20/35
R-410
330
R-408
8.2 K
R-407
220
C-406
30/15
R-507
75, 5W
K-501
(1) 150 Ω
0
+182
R-506
100
2 W
(2) 100 Ω
+171
C-502 B
20/250
C-502 C
100/250
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A—GROUND
SPEAKER GROUND
+300 TRANSMIT
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160 CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
.0
K-501 TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

ECTED.
TION AND
H NORMAL
OR
SCILLOSCOPE
TER OR

TEST DATA LINE

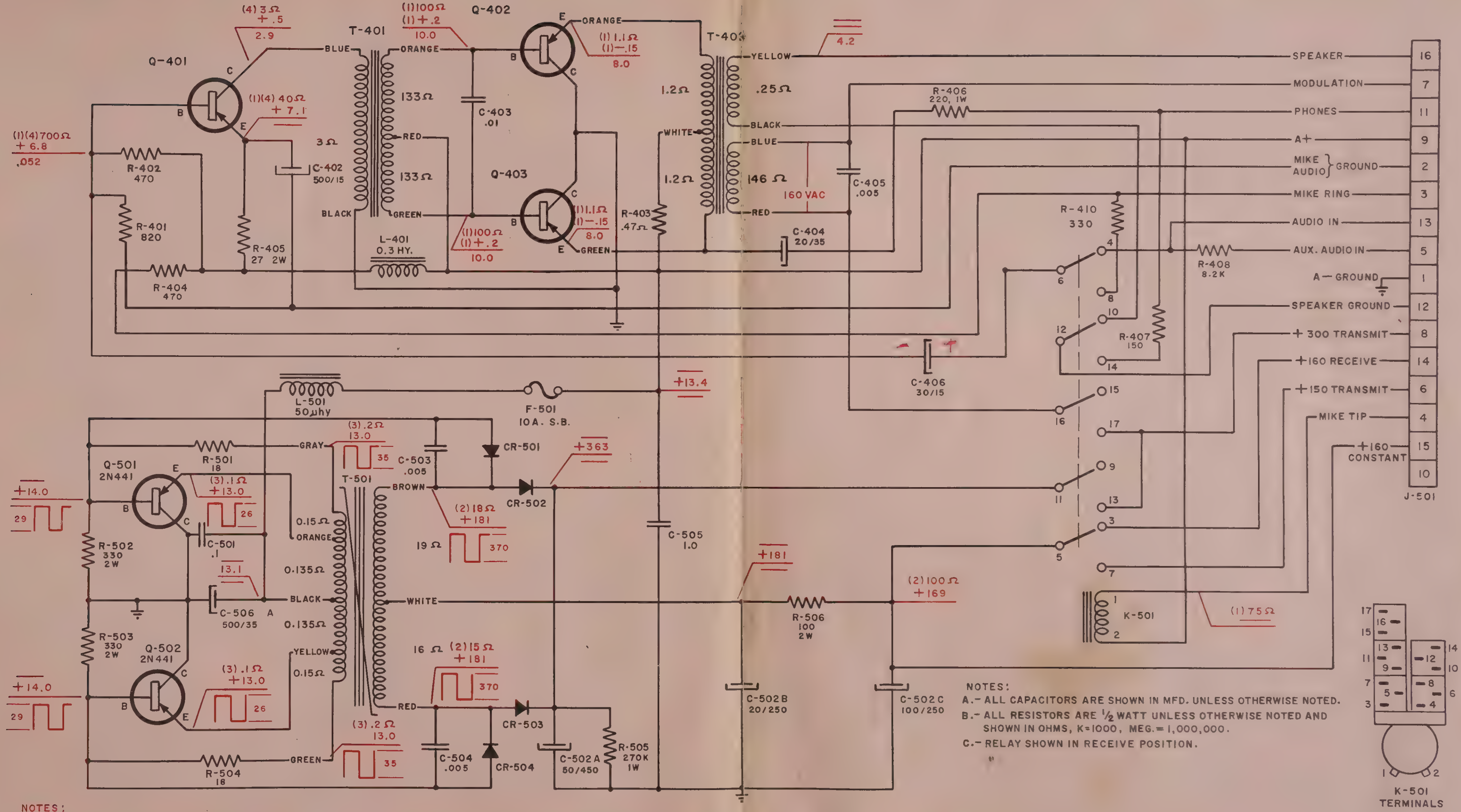
RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR

WAVE SHAPE & P-P VOLTAGE

Figure 13a.
SCHEMATIC, MODULATOR POWER UNIT T-24MP-12
for *narco* Mark-12 operation on 24 Volts.
CNPB89-B


Q-401
Q-402
Q-403
T-401
T-402
BLUE
ORANGE
RED
GREEN
BLACK
YELLOW
WHITE
133Ω
3Ω
1.2Ω
.25Ω
146 Ω
160 VAC
C-402 500/15
C-403 .01
C-404 20/35
C-405 .005
C-406 30/15
R-401 820
R-402 470
R-403 .47Ω
R-404 470
R-405 27 2W
R-406 220, 1W
R-407 150
R-408 8.2K
R-410 330
L-401 0.3 HY.
(4) 3Ω + .5 2.9
(1)(4) 40Ω + 7.1
(1)(4) 700Ω + 6.8 .052
(1) 100Ω (1) + .2 10.0
(1) 1.1Ω (1) −.15 8.0
4.2
+13.4
L-501 50μhy
F-501 10A. S.B.
Q-501 2N441
Q-502 2N441
R-501 18
R-502 330 2W
R-503 330 2W
R-504 18
R-505 270K 1W
R-506 100 2W
C-501 .1
C-503 .005
C-504 .005
C-505 1.0
C-506 500/35
C-502 A 50/450
C-502 B 20/250
C-502 C 100/250
CR-501
CR-502
CR-503
CR-504
T-501
GRAY
BROWN
+14.0
29
(3) .1Ω +13.0 26
13.1
(3) .2Ω 13.0 35
(2) 18Ω +181
19 Ω 370
16 Ω (2) 15Ω +181 370
+363
+181
(2) 100Ω +169
(1) 75Ω
0.15Ω
0.135Ω
K-501
SPEAKER 16
MODULATION 7
PHONES 11
A+ 9
MIKE AUDIO GROUND 2
MIKE RING 3
AUDIO IN 13
AUX. AUDIO IN 5
A− GROUND 1
SPEAKER GROUND 12
+300 TRANSMIT 8
+160 RECEIVE 14
+150 TRANSMIT 6
MIKE TIP 4
+160 CONSTANT 15
10
J-501
K-501 TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES:

(1) - MEASURED WITH RESPECT TO A+, PIN-9.

(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.

(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.

(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READING TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS OF AUDIO OUT, WITH NORMAL 13.75 V. INTO POWER CABLE AT MARK-12. (AUDIO FREQUENCY 1000 CYCLES)

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE

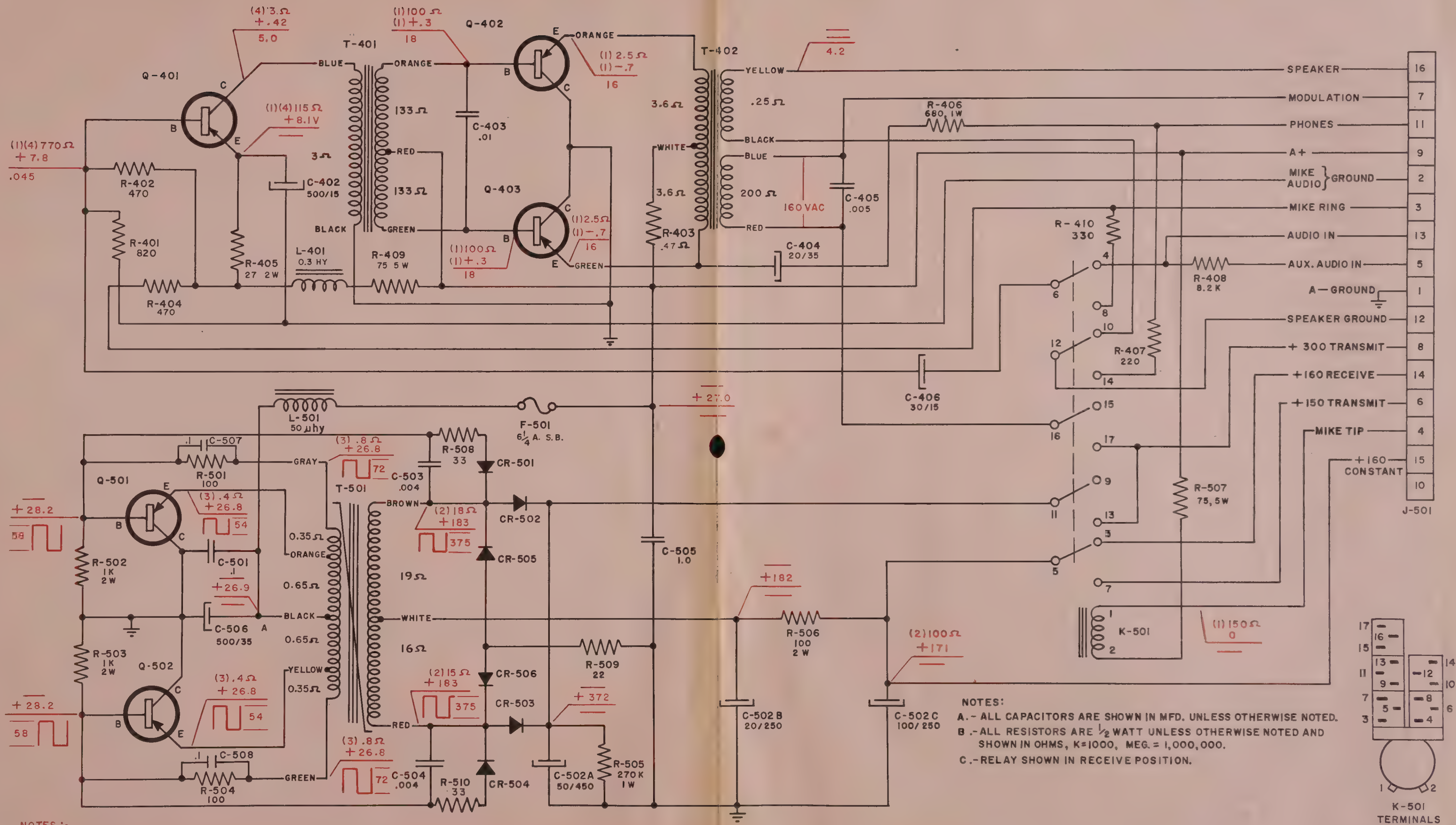
RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR WAVE SHAPE & P-P VOLTAGE

Ref. T-02178-J 2-14-64 ECN-4250

Figure 12a.
SCHEMATIC, MODULATOR POWER UNIT, T-12MP-12, for *narco* Mark-12 operation on 12 Volts.
CNPA89-B


Q-401
Q-402
Q-403
Q-501
Q-502
T-401
T-402
T-501
L-401
0.3 HY
L-501
50 μhy
R-401
820
R-402
470
R-404
470
R-405
27 2W
R-409
75 5W
R-403
.47Ω
R-406
680, 1W
R-410
330
R-408
8.2K
R-407
220
R-507
75, 5W
R-501
100
R-502
1K
2W
R-503
1K
2W
R-504
100
R-505
270K
1W
R-506
100
2W
R-508
33
R-509
22
R-510
33
C-402
500/15
C-403
.01
C-404
20/35
C-405
.005
C-406
30/15
C-501
.1
C-503
.004
C-504
.004
C-505
1.0
C-506
500/35
C-507
.1
C-508
.1
C-502A
50/450
C-502B
20/250
C-502C
100/250
CR-501
CR-502
CR-503
CR-504
CR-505
CR-506
F-501
6¼ A. S.B.
K-501
160 VAC
BLUE
ORANGE
RED
BLACK
GREEN
YELLOW
WHITE
GRAY
BROWN
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A—GROUND
SPEAKER GROUND
+300 TRANSMIT
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160 CONSTANT
J-501
K-501
TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES :-

(1) - MEASURED WITH RESPECT TO A +, PIN-9.

(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.

(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.

(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPE[illegible]TION AND 4.5 WATTS OF AUDIO OUT (FREQUENCY 1000 CYCLES), W[illegible]H NORMAL 27.5V. INTO POWER CABLE AT MARK-12.

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE

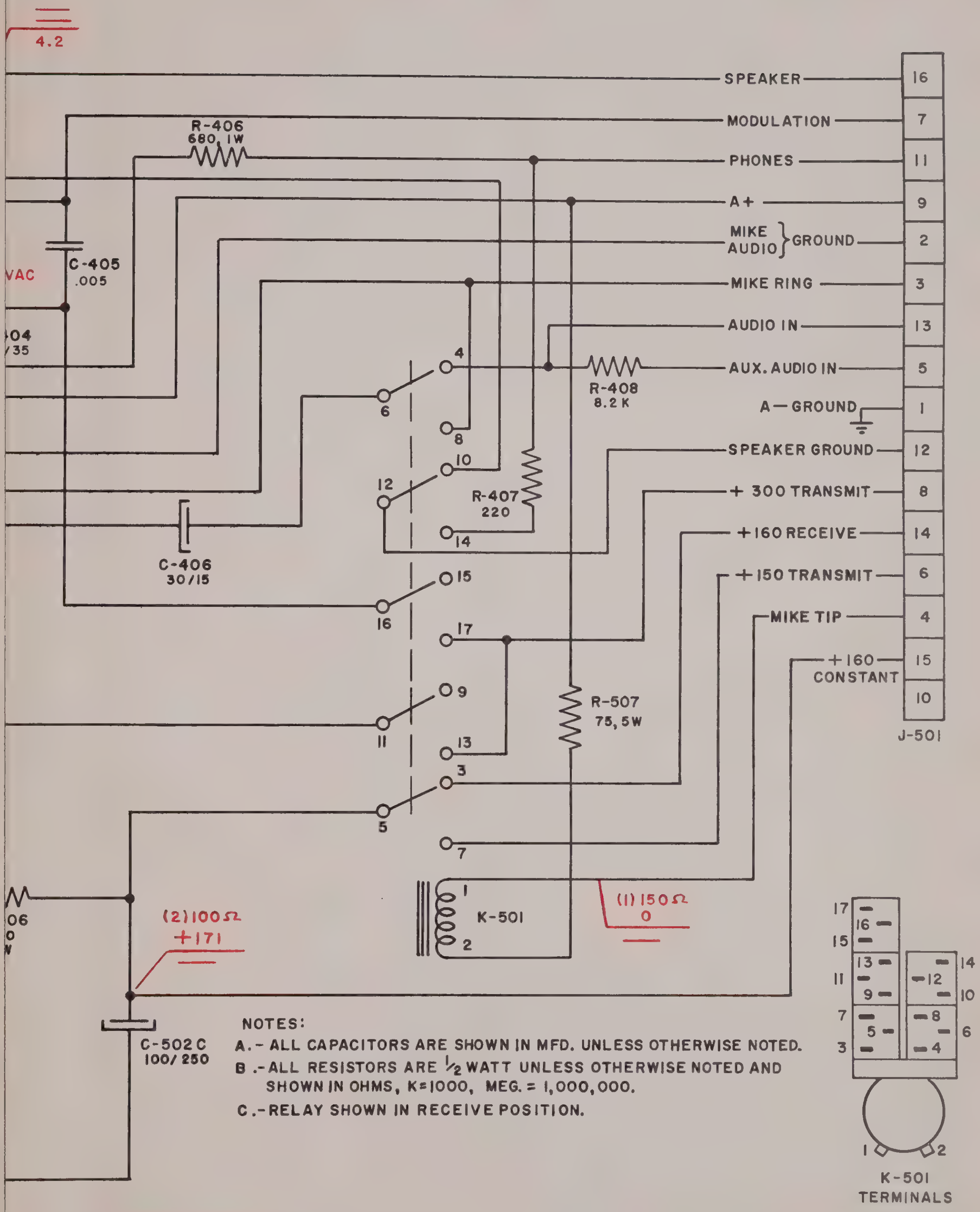
RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Figure 13a.
SCHEMATIC, MODULATOR POWER UNIT T-24MP-12
for ***narco*** Mark-12 operation on 24 Volts.
CNPB89-B

Ref. T-02183-D 4-10-64 ECN-4304


4.2
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A—GROUND
SPEAKER GROUND
+ 300 TRANSMIT
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160 CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
R-406 680, 1W
C-405 .005
VAC
04 /35
R-408 8.2 K
R-407 220
C-406 30/15
R-507 75, 5W
K-501
(1) 150Ω 0
(2) 100Ω +171
06 0 W
C-502 C 100/250
K-501 TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

TEST DATA LINE

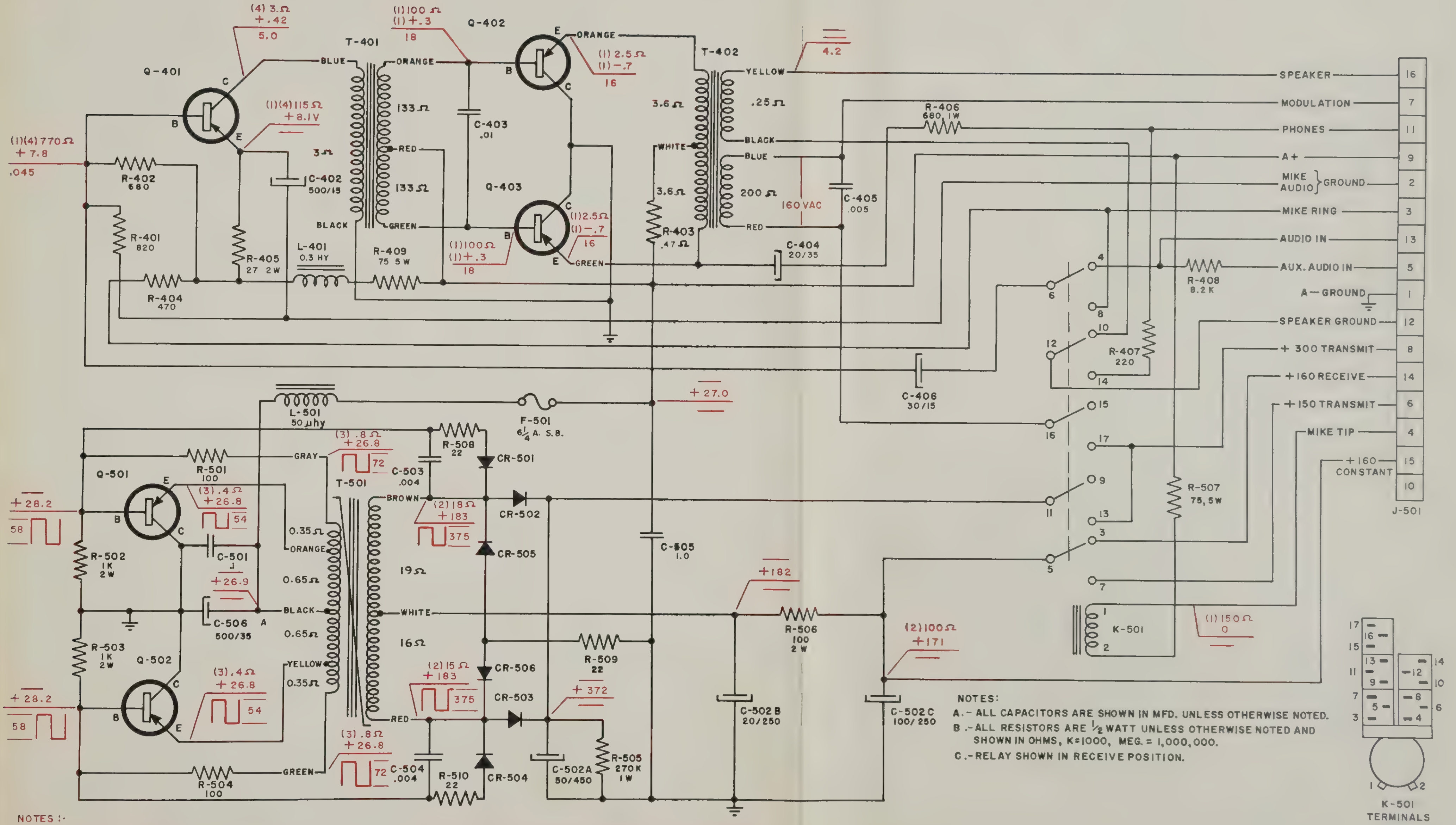
RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Figure 13.

SCHEMATIC, MODULATOR POWER UNIT T-24MP-12
for *narco* Mark-12 operation on 24 Volts.
CNPB89-A


Q-401
Q-402
Q-403
Q-501
Q-502
T-401
T-402
T-501
R-401 820
R-402 680
R-403 .47 Ω
R-404 470
R-405 27 2W
R-406 680, 1W
R-407 220
R-408 8.2 K
R-409 75 5W
L-401 0.3 HY
C-402 500/15
C-403 .01
C-404 20/35
C-405 .005
C-406 30/15
(1)(4) 770 Ω
+ 7.8
.045
(4) 3 Ω
+ .42
5.0
(1)(4) 115 Ω
+ 8.1V
(1) 100 Ω
(1) + .3
18
(1) 2.5 Ω
(1) − .7
16
3 Ω
133 Ω
133 Ω
3.6 Ω
3.6 Ω
.25 Ω
200 Ω
160 VAC
4.2
BLUE
ORANGE
RED
BLACK
GREEN
YELLOW
WHITE
SPEAKER
MODULATION
PHONES
A +
MIKE AUDIO } GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A — GROUND
SPEAKER GROUND
+ 300 TRANSMIT
+ 160 RECEIVE
+ 150 TRANSMIT
MIKE TIP
+ 160 CONSTANT
J-501
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
K-501
(1) 150 Ω
0
R-501 100
R-502 1K 2W
R-503 1K 2W
R-504 100
R-505 270K 1W
R-506 100 2W
R-507 75, 5W
R-508 22
R-509 22
R-510 22
L-501 50 μhy
F-501 6¼ A. S.B.
C-501 .1
C-502A 50/450
C-502B 20/250
C-502C 100/250
C-503 .004
C-504 .004
C-505 1.0
C-506 500/35
CR-501
CR-502
CR-503
CR-504
CR-505
CR-506
+ 27.0
+ 28.2
58
+ 28.2
58
(3) .4 Ω
+ 26.8
54
(3) .4 Ω
+ 26.8
54
+ 26.9
(3) .8 Ω
+ 26.8
72
(3) .8 Ω
+ 26.8
72
(2) 18 Ω
+ 183
375
(2) 15 Ω
+ 183
375
+ 372
+ 182
(2) 100 Ω
+ 171
0.35 Ω
0.65 Ω
0.65 Ω
0.35 Ω
19 Ω
16 Ω
GRAY
BROWN
K-501 TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES :-

(1) - MEASURED WITH RESPECT TO A +, PIN-9.

(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.

(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.

(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS OF AUDIO OUT (FREQUENCY 1000 CYCLES), WITH NORMAL 27.5V. INTO POWER CABLE AT MARK-12.

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE

RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Ref. T-02183-A 3-26-63

Figure 13.

SCHEMATIC, MODULATOR POWER UNIT T-24MP-12
for *narco* Mark-12 operation on 24 Volts.
CNPB89-A

narco MARK-12 VHF Transceiver

with

NAVIGATION RECEIVER

and

T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL

SUPPLEMENT No. 1

for

CN89-B and CNP89-B

with

Corrections, Changes and Additions

for the

Original Manual

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

Printed in U.S.A. MM-211 September, 1963

SECTION 1
GENERAL INFORMATION

1-A. INTRODUCTION.

This is Supplement No. 1 to the ***narco*** Mark-12 Maintenance Manual, MM-211, April 1963. It is concerned primarily with Panel Units having Chassis Numbers CN-89-B and CNP-89-B.

It also contains a few minor corrections, changes or additions to the original manual. The corrections, changes, or additions are referenced to the corresponding pages, sections, and paragraphs in the original manual.

1-A,1. Panel Unit

Add the following paragraph: (Ref. page 7)

A squelch control has been provided for the Communications Receiver. It is a small knob, marked "SQ.", concentric with the Communication Receiver Volume Control knob. These knobs are near the top of the panel, just to the left of the center. See PHOTO Aa., page 66.

1-B. SPECIFICATIONS.

1-B,3. Communications Receiver

Add the following item: (Ref. page 8)

Squelch.
Maximum squelch (knob fully counterclockwise) should be overcome by signal input levels of 10 to 25 microvolts.

SECTION 2
INSTALLATION

2-C. ACCESSORIES REQUIRED, but Not Supplied.

Corrections: (Ref. page 9)

Item 4. Delete the phrase: "See Section J,1., below."

Item 5. Should read:...................., See Section 2-H,2., page 12.

Item 6. Should read:...................., See Section 2-D,1,a., below.

2-D. OPTIONAL UNITS and ACCESSORIES AVAILABLE.

Addition: (Ref. page 10)

2-D,4. Tone Filter

a. Tone Filter, narco Type VP-12, ***narco*** Part No. EL-2070.

2-F. ELECTRICAL CONNECTIONS.

2-F,1. Modulator-Power and Accessory Cable.

Corrections: (Ref. page 10)

In the first line of the second paragraph read:..........(See 2-C., 1., page 9)..........

2-F,2. Navigation Cable

In the fifth line of the first paragraph read: ....are given in Table V, page 30 and in............

2-F,3. Glide Slope Channel Selector Cable.

Correction: (Ref. page 11)

In the last line of the second paragraph read: ....(See 2-D,1a., page 9).

2-J. POST-INSTALLATION CHECKOUT.

Add the following paragraph: (Ref. page 12)

With minimum squelch (knob fully clockwise) background noise should be present, on all channels, at the speaker output terminals.

SECTION 3
OPERATION

3-A. INTRODUCTION.

3-A,1. Panel Unit Controls.

Addition: (Ref. page 13)

Amend the first sentence of the introductory paragraph to read:

The controls consist of two Channel Selectors, two Volume Controls, an ON-OFF Primary DC Power Switch and a Squelch Control for the Communications Receiver.

Under:
a. Communication Transceiver.

Add the following paragraph:

The knob concentric with but behind the COM Volume Control Knob, operates the Squelch Control. It is marked "SQ". The weakest signals will be received with the "SQ" control in the maximum clockwise position.

SECTION 4
CIRCUIT DESCRIPTION

4-C. COMMUNICATIONS RECEIVER.

Additions: (Ref. pages 14 and 15)

Amend the last sentence of the third paragraph in the first column of page 15, to read:

The output of the audio volume control is applied via C-348, CR-104, C-161 and R-319 to the control grid of the cathode follower V-305-B.

Refer to the supplementary Schematic, Figure 11a., page 69.

Add the following two new paragraphs:

Squelch Control is accomplished by biasing a silicon diode, CR-104, "ON" or "OFF". This diode controls the signal of the Communications Receiver Audio to the cathode follower V-305-B. The diode (CR-104) is reverse biased "OFF" by turning the squelch control, R-138, in the counter-clockwise direction. This makes the DC voltage on the cathode (of CR-104) equal to or greater than that on its anode. The D.C. voltage on the anode of CR-104 is controlled by the screen grid voltage of the first LF IF Amplifier V-104.

When a signal is received AVC voltage will be developed, the current through V-104 will be reduced and its screen voltage will increase. This voltage increase is applied to the anode of CR-104 and forward biases it "ON". When the signal ceases the AVC voltage will disappear and the V-104 screen grid voltage will decrease. The anode voltage on CR-104 will, therefore, decrease causing it to return to the reverse biased "OFF" condition.

SECTION 5
MAINTENANCE

5-E. COMMUNICATIONS RECEIVER ALIGNMENT.

5-E,9. Automatic Volume Control (AVC)

First paragraph: (Ref. page 24)

Amend the last sentence to read: (Ref. page 24)

This potential with no signal applied, should be between minus 0.5 and minus 0.8 VDC.

Second paragraph.

Change the value 0.2 VDC to minus 0.5 VDC.

Third paragraph.

Change the value 0.2 VDC to minus 0.8 VDC.

Fourth paragraph

No change.

Add the following new subsection:

5-E,10. Squelch.

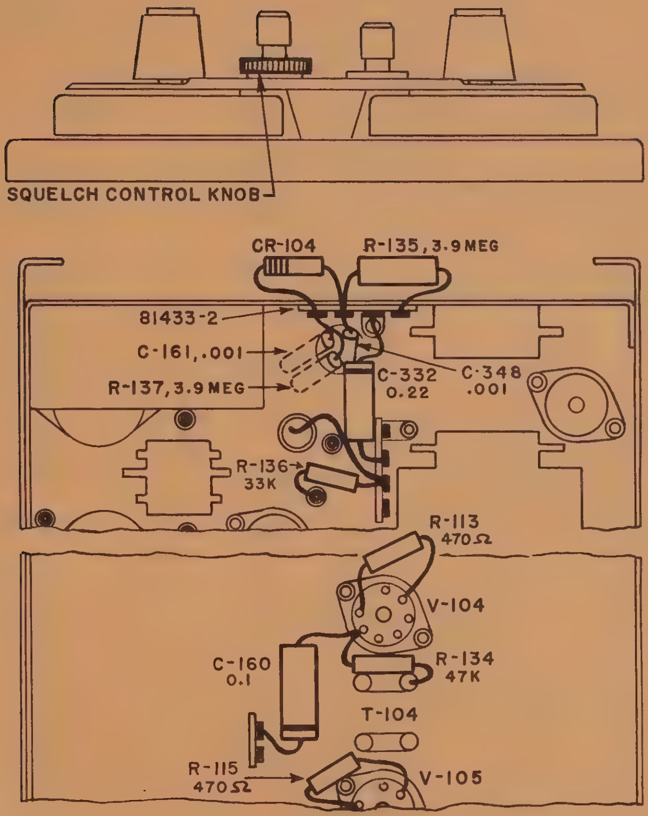
Refer to the supplementary Schematic, Figure 11a., page 69.

The squelch will operate with a very small signal input to the receiver. A signal input of 25 microvolts should overcome the maximum squelch (Squelch Control, R-138, in the maximum counter-clockwise position).

If a 25 microvolt signal will not overcome maximum squelch,, the resistor R-139 (100K ohms) may be shunted with a value of resistance that will allow the signal to overcome the maximum CCW squelch setting.

If the squelch is overcome (opened) by too small an input signal (less than about 5 microvolts), the resistor R-136 (33K ohms) may be shunted with a value of resistance that will require an input signal of 10 to 25 microvolts to overcome the maximum counter-clockwise squelch setting.

Any adjustment of the squelch circuit should be done at the center frequency of the receiver tuning range.


SQUELCH CONTROL KNOB
CR-104
R-135, 3.9 MEG
81433-2
C-161, .001
R-137, 3.9 MEG
C-332
0.22
C-348
.001
R-136
33K
R-113
470Ω
V-104
C-160
0.1
R-134
47K
T-104
R-115
470Ω
V-105

BOTTOM VIEW
SUPPLEMENT No. 1, for PHOTOS D and E.
pages 38 and 39.

SECTION 7
REPLACEMENT PARTS

7-A. INTRODUCTION.

Provided, herewith, is a supplementary "List of Replacement parts ". It was prepared primarily to provide for parts added in Mark-12 Panel Units having Chassis No. CN-89-B and CNP-89-B.

This list also contains some corrections or additions to the original "7-B. LIST of PARTS" in MM-211, pages 43 thru 54.

Where no part number appears in this list, the number given in the original list applies.

The items in this list marked with an asterisk (*) are corrections or additions for the original list.

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS	
C-137*	24049-120	Dipped Mica, 500V, 12 micromicrofarads ±1.0 micromicrofarads	
C-160	23085-125	Mylar, 200V, 0.1 μfd, ±20%	CN-89-B, CNP-89-B
C-161	23085-151	Mylar, Tubular, 200V, .001 mfd, ±10%	CN-89-B, CNP-89-B
C-301	21201-100	Same as C-253	Early Production
C-301	21201-829	Ceramic Tub., 500V., 8.2μμf, ±0.5μμf	Later Production
C-348	21291-21	Same as C-106	CN-89-A, CNP-89-A
C-348	23085-151	Same as C-161	CN-89-B, CNP-89-B
		CR, DIODES	
CR-101*	75013-5	Diode, Silicon, CN12227 (Similar to 1N459)	CN-89-A, CNP-89-A CN-89-B, CNP-89-B
CR-102	75019-1	Diode, Silicon, IN914	CN-89-A, CNP-89-A CN-89-B, CNP-89-B Early Production
CR-102	75019-2	Diode, Silicon, CD6487	CN-89-A, CNP-89-A CN-89-B, CNP-89-B Later Production
CR-103*	75013-4	Diode, Silicon, CD12226 (Similar to 1N457)	CN-89-A, CNP-89-A CN-89-B, CNP-89-B
CR-104	74013-4	Same as CR-103	CN-89-B, CNP-89-B
		Q, TRANSISTORS	
Q-401	75510-2	Transistor,, Driver	Early Production
Q-401	75534-4	Transistor, Audio Driver	Later Production
Q-402	75510-4	Transistor, Audio Output	24V. Mod-Pwr Unit Early Production
Q-402	75534-3	Transistor, Audio Output	24 V. Mod-Pwr Unit Later Production
Q-403	75510-4	Same as Q-402	12V. Mod-Pwr Unit Early Production
Q-403	75534-3	Same as Q-402	12V. Mod-Pwr Unit Later Production
		R, RESISTORS	
R-113	31141-122	Carbon, 1/2W, 1.2K ohms, ±10%	CNP-89-A.
R-113	31141-471	Carbon, 1/2W ,470 ohms, ±10%	CN-89-A, CN-89-B, CNP-89-B.
R-115	31141-821	Same as R-107	CNP-89-A.
R-115	31141-471	Same as R-113 for CN-89-A, CN-89-B, CNP-89-B	CNP-89-A, CNP-89-B, CN-89-B.

* Indicates a correction or addition for the original Replacement Parts List.

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-120	31141-102	Same as R-110	CN-89-A, CNP-89-A
R-120	31141-561	Carbon, 1/2W, 560 ohms, ±10%	CN-89-B, CNP-89-B
R-122	32040-1	Potentiometer, 1/2W, 1 Megohm	CN-89-A, CNP-89-A, Volume Control
R-122	32033-1	Potentiometer, 1/2W, 1 Megohm	CN-89-B, CNP-89-B, Volume Control
R-133	31141-222	Carbon, 1/2W, 2.2K ohms, ±10%	CNP-89-A
R-134	31141-473	Same as R-102	CN-89-B, CNP-89-B
R-135	31141-395	Carbon, 1/2W, 3.9 Megohms, ±10%	CN-89-B, CNP-89-B
R-136	31149-333	Carbon, 1/2W, 33K ohms, ±5%	CN-89-B, CNP-89-B
R-137	31141-395	Same as R-135	CN-89-B, CNP-89-B
R-138	32033-1	Part of R-122 Assembly, Pot. 50K ohms	CN-89-B, CNP-89-B Squelch Control
R-139	31149-104	Carbon, 1/2W, 100K ohms, ±5%	CN-89-B, CNP-89-B
R-402	31141-681	Carbon, 1/2W, 680 ohms, ±10%	Early Production
R-402	31141-471	Same as R-113 for CN-89A, CN-89-B, CNP-89-B	Later Production
R-407*	31141-221	Same as R-103,	24 Volt Unit
R-408*	31141-822	Carbon, 1/2W, 8.2K ohms, ±10%	

S, SWITCHES

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
S-101	32040-1	Switch, Part of Assembly R-122	CN-89-A, CNP-89-A +DC On-Off
S-101	32033-1	Switch, Part of Assembly R-122	CN-89-B, CNP-89-B +DC On-Off
S-102	32040-1	Switch, Part of Assembly R-122	CN-89-A, CNP-89-A Speaker Ground
S-102	32033-1	Switch, Part of Assembly R-122	CN-89-B, CNP-89-B Speaker Ground

T, TRANSFORMERS

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
T-401*	11821-102	Transformer, Driver	12 and 24V Units
T-402*	11821-101	Transformer, Audio Output	12 Volt Units
T-402*	11633-101	Transformer, Audio Output	24 Volt Units

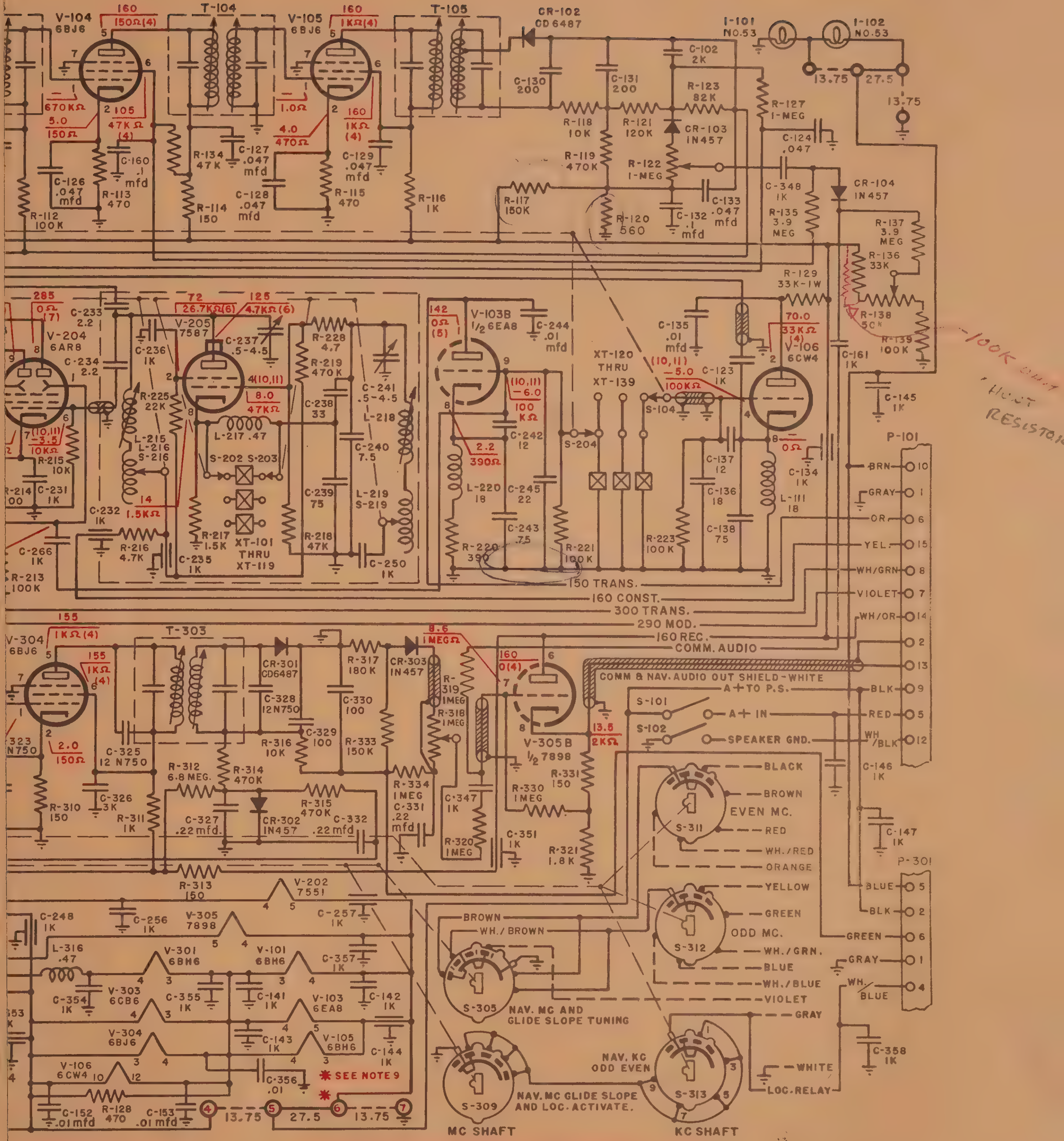
XT, CRYSTALS, QUARTZ, SUBMINIATURE

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
XT-121*	72007-141	9.425 Mc, for .05 Fractional Mc	COM Transceiver
XT-122*	72007-142	9.375 Mc, for .10 Fractional Mc	COM Transceiver
XT-123*	72007-143	9.325 Mc, for .15 Fractional Mc	COM Transceiver
XT-124*	72007-144	9.275 Mc, for .20 Fractional Mc	COM Transceiver
XT-125*	72007-145	9.225 Mc, for .25 Fractional Mc	COM Transceiver

MISCELLANEOUS (No Symbol)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
None*	61404-101	Assembly, Detent Roller	COM. Kc
None*	66507-1	Fuse Holder	MOD-PWR Unit
None*	81330-3	Washer, Shoulder	For Mod-PWR Unit Q-401.
None*	81622-3	Clip, Tube Pin Type	For Mod-Pwer Unit Q-401, Q-402, & Q-403.
None	88148-2	Knob	Squelch Control

* Indicates a correction or addition for the original Replacement Parts List.


V-104
6BJ6
160
150Ω(4)
T-104
V-105
6BJ6
160
1KΩ(4)
T-105
CR-102
CD 6487
I-101
NO.53
I-102
NO.53
C-102
2K
C-130
200
C-131
200
R-123
82K
R-127
1-MEG
13.75
27.5
13.75
670KΩ
5.0
150Ω
47KΩ
(4)
1.0Ω
4.0
470Ω
160
1KΩ
(4)
R-118
10K
R-121
120K
CR-103
IN457
C-124
.047
R-134
47K
C-127
.047
mfd
C-160
.1
mfd
C-129
.047
mfd
R-119
470K
R-122
1-MEG
C-126
.047
mfd
R-113
470
C-128
.047
mfd
R-115
470
R-116
1K
R-117
150K
C-348
1K
CR-104
IN457
R-112
100K
R-114
150
R-120
560
C-132
.1
mfd
C-133
.047
mfd
R-135
3.9
MEG
R-137
3.9
MEG
R-136
33K
R-129
33K-1W
R-138
5CK
R-139
100K
285
0Ω
(7)
C-233
2.2
V-204
6AR8
C-234
2.2
72
26.7KΩ(6)
125
4.7KΩ(6)
V-205
7587
C-236
1K
C-237
.5-4.5
R-228
4.7
R-219
470K
142
0Ω
(5)
V-103B
1/2 6EA8
C-244
.01
mfd
C-135
.01
mfd
70.0
33KΩ
(4)
V-106
6CW4
C-161
1K
R-225
22K
4(10,11)
8.0
47KΩ
C-238
33
C-241
.5-4.5
L-218
(10,11)
-6.0
100
KΩ
XT-120
THRU
XT-139
(10,11)
-5.0
100KΩ
C-123
1K
C-145
1K
(10,11)
-3.5
10KΩ
R-215
10K
L-215
L-216
S-216
L-217 .47
C-242
12
C-240
7.5
S-204
S-104
P-101
S-202 S-203
2.2
390Ω
0Ω
C-137
12
C-134
1K
BRN
GRAY
OR
YEL
WH/GRN
VIOLET
WH/OR
BLK
RED
WH /BLK
R-214
00
C-231
1K
14
1.5KΩ
C-239
75
L-219
S-219
L-220
18
C-245
22
C-136
18
L-111
18
C-232
1K
R-216
4.7K
R-217
1.5K
XT-101
THRU
XT-119
R-218
47K
C-243
.75
R-220
390
R-221
100K
R-223
100K
C-138
75
C-266
1K
R-213
100K
C-235
1K
C-250
1K
150 TRANS.
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM. AUDIO
155
V-304
6BJ6
1KΩ (4)
T-303
155
1KΩ
(4)
CR-301
CD6487
R-317
180K
8.6
1MEGΩ
CR-303
IN457
R-319
1MEG
R-318
1MEG
160
0(4)
COMM & NAV. AUDIO OUT SHIELD-WHITE
A+TO P.S.
S-101
A+ IN
S-102
SPEAKER GND.
C-328
12N750
C-330
100
C-329
100
323
N750
2.0
150Ω
C-325
12 N750
R-316
10K
R-333
150K
V-305B
1/2 7898
13.8
2KΩ
R-312
6.8 MEG.
R-314
470K
R-334
1MEG
R-331
150
C-146
1K
BLACK
BROWN
EVEN MC.
S-311
RED
WH./RED
ORANGE
R-310
150
C-326
3K
R-311
1K
C-327
.22 mfd.
CR-302
IN457
R-315
470K
C-332
.22 mfd
C-331
.22
mfd
C-347
1K
R-330
1MEG
R-320
1MEG
C-351
1K
R-321
1.8K
C-147
1K
P-301
R-313
150
V-202
7551
YELLOW
BLUE
BLK
C-248
1K
C-256
1K
V-305
7898
C-257
1K
BROWN
WH./BROWN
GREEN
ODD MC.
S-312
WH./GRN.
BLUE
WH./BLUE
VIOLET
GRAY
GREEN
GRAY
WH./BLUE
L-316
.47
V-301
6BH6
V-101
6BH6
C-357
1K
C-354
1K
V-303
6CB6
C-355
1K
C-141
1K
V-103
6EA8
C-142
1K
S-305
NAV. MC AND
GLIDE SLOPE TUNING
V-304
6BJ6
C-143
1K
V-105
6BH6
C-144
1K
NAV. KC
ODD EVEN
C-358
1K
V-106
6CW4
C-356
.01
SEE NOTE 9
S-309
NAV. MC GLIDE SLOPE
AND LOC. ACTIVATE.
S-313
WHITE
LOC. RELAY
C-152
.01mfd
R-128
470
C-153
.01 mfd
13.75
27.5
13.75
MC SHAFT
KC SHAFT
-100K
RESISTOR

RED TO TERMINAL 15 OF P-101.
RED TO TERMINAL 8 OF P-101.
RED TO TERMINAL 7 OF P-101.
ALS 4,5,6, AND 7 ARE LOCATED ON THE 8 TERMINAL
STRIP MOUNTED BENEATH THE VOLUME CONTROLS.
FROM FRONT, TERMINALS ARE NUMBERED FROM
O LEFT.

10.- VOLTAGES SHOWN ARE AVERAGE, VARIATIONS OF ± 20 % CAN BE EXPECTED.

11.- MEASURED THRU A 1 MEG. OHM RESISTOR.

12.- MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10 MC) VOLTMETER.

13.- VOLTAGE SHOWN ABOVE LINE - EXAMPLE $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$

Figure 11a.
SCHEMATIC, ***narco*** Mark-12, PANEL UNIT
For CN-89-B and CNP-89-B
T-02177A-Rev. V

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-120	31141-102	Same as R-110	CN-89-A, CNP-89-A
R-120	31141-561	Carbon, 1/2W, 560 ohms, ±10%	CN-89-B, CNP-89-B
R-122	32040-1	Potentiometer, 1/2W, 1 Megohm	CN-89-A, CNP-89-A, Volume Control
R-122	32033-1	Potentiometer, 1/2W, 1 Megohm	CN-89-B, CNP-89-B, Volume Control
R-133	31141-222	Carbon, 1/2W, 2.2K ohms, ±10%	CNP-89-A
R-134	31141-473	Same as R-102	CN-89-B, CNP-89-B
R-135	31141-395	Carbon,, 1/2W, 3.9 Megohms, ±10%	CN-89-B, CNP-89-B
R-136	31149-333	Carbon, 1/2W, 33K ohms, ±5%	CN-89-B, CNP-89-B
R-137	31141-395	Same as R-135	CN-89-B, CNP-89-B
R-138	32033-1	Part of R-122 Assembly, ,Pot. 50K ohms	CN-89-B, CNP-89-B Squelch Control
R-139	31149-104	Carbon, 1/2W, 100K ohms, ±5%	CN-89-B, CNP-89-B
R-402	31141-681	Carbon, 1/2W, 680 ohms, ±10%	Early Production
R-402	31141-471	Same as R-113 for CN-89A, CN-89-B, CNP-89-B	Later Production
R-407*	31141-221	Same as R-103,	24 Volt Unit
R-408*	31141-822	Carbon, 1/2W, 8.2K ohms, ±10%	
		S, SWITCHES	
S-101	32040-1	Switch,, Part of Assembly R-122	CN-89-A, CNP-89-A +DC On-Off
S-101	32033-1	Switch, Part of Assembly R-122	CN-89-B, CNP-89-B +DC On-Off
S-102	32040-1	Switch,, Part of Assembly R-122	CN-89-A, CNP-89-A Speaker Ground
S-102	32033-1	Switch, Part of Assembly R-122	CN-89-B, CNP-89-B Speaker Ground
		T, TRANSFORMERS	
T-401*	11821-102	Transformer, ,Driver	12 and 24V Units
T-402*	11821-101	Transformer, Audio Output	12 Volt Units
T-402*	11633-101	Transformer, Audio Output	24 Volt Units
		XT, CRYSTALS, QUARTZ, SUBMINIATURE	
XT-121*	72007-141	9.425 Mc, for .05 Fractional Mc	COM Transceiver
XT-122*	72007-142	9.375 Mc, for .10 Fractional Mc	COM Transceiver
XT-123*	72007-143	9.325 Mc, for .15 Fractional Mc	COM Transceiver
XT-124*	72007-144	9.275 Mc, for .20 Fractional Mc	COM Transceiver
XT-125*	72007-145	9.225 Mc, for .25 Fractional Mc	COM Transceiver
		MISCELLANEOUS (No Symbol)	
None*	61404-101	Assembly, Detent Roller	COM. Kc
None*	66507-1	Fuse Holder	MOD-PWR Unit
None*	81330-3	Washer, Shoulder	For Mod-PWR Unit Q-401.
None*	81622-3	Clip, Tube Pin Type	For Mod-Pwer Unit Q-401, Q-402, & Q-403.
None	88148-2	Knob	Squelch Control

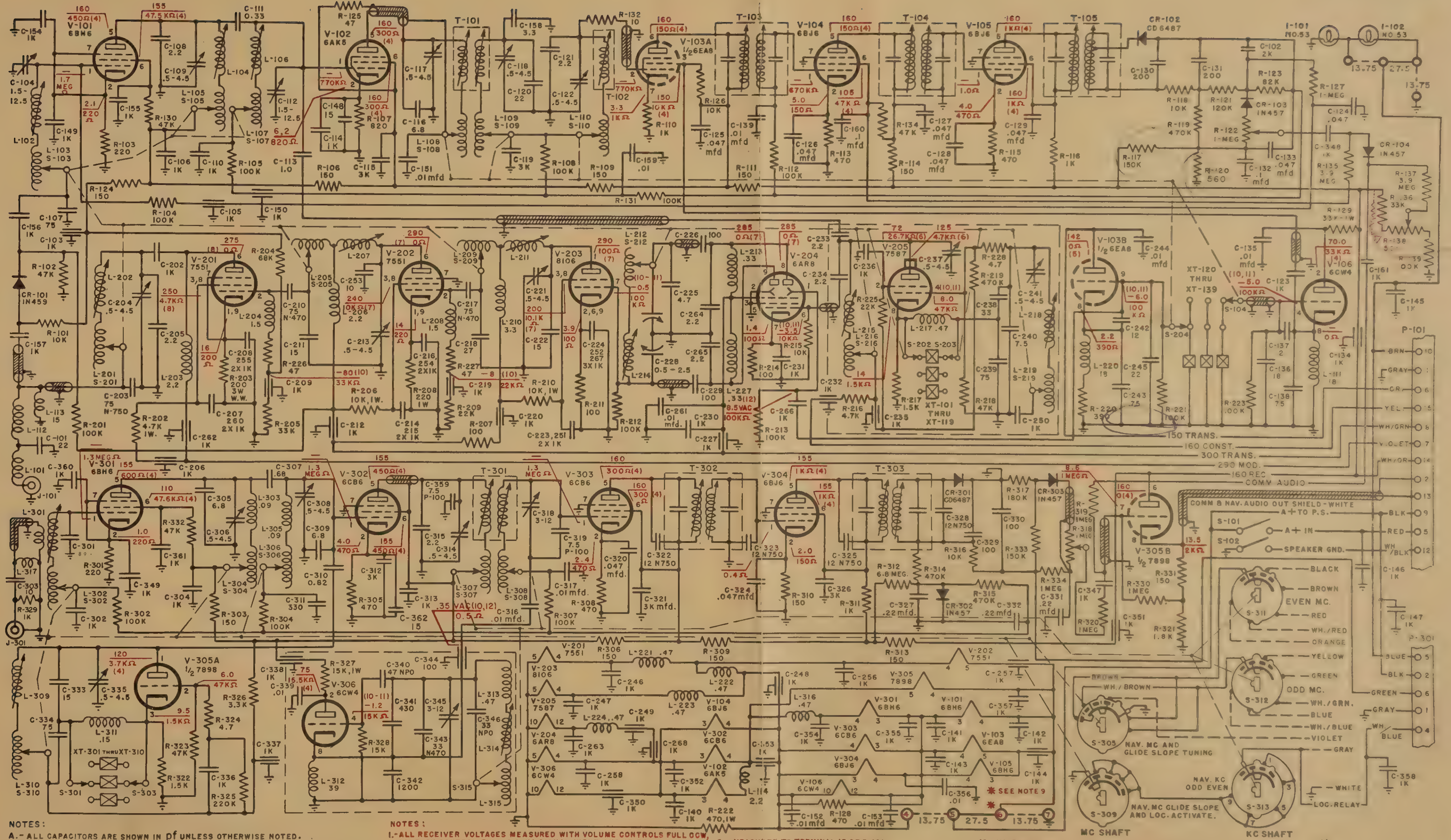
* Indicates a correction or addition for the original Replacement Parts List.

8-A. INTRODUCTION.

This schematic is similar to Figure 11, page 55, but it represents the later production Panel Units having the Chassis Number CN-89-B or CNP-89-B. These Units have the Squelch Control Associated with the COM Receiver.

Correction:

The Schematics, Figures 12 and 13, pages 56 and 57, for the 12 Volt and 24 Volt versions of the MP-12 Modulator-Power Units respectively, have only one change affecting the current production Units. The bias resistor, R-402, for the base of the Audio input transistor Q-401 has been changed from 680 ohms to 470 ohms, to improve modulation.


V-101 6BH6
V-102 6AK5
T-101
V-103A ½ 6EA8
T-102
T-103
V-104 6BJ6
T-104
V-105 6BH6
T-105
CR-102 CD6487
I-101 NO.53
I-102 NO.53
V-201 7551
V-202 7551
V-203 8106
V-204 6AR8
V-205 7587
V-103B ½ 6EA8
V-106 6CW4
XT-120 THRU XT-139
XT-101 THRU XT-119
P-101
V-301 6BH6
V-302 6CB6
T-301
V-303 6CB6
T-302
V-304 6BJ6
T-303
CR-301 CD6487
CR-303 IN457
V-305B ½ 7898
V-305A ½ 7898
V-306 6CW4
XT-301 THRU XT-310
S-301
S-303
J-101
J-301
150 TRANS.
160 CONST.
300 TRANS.
290 MOD.
160 REC.
COMM AUDIO
COMM & NAV. AUDIO OUT SHIELD-WHITE
A+ TO P.S.
S-101
S-102
A+ IN
SPEAKER GND.
EVEN MC.
ODD MC.
S-311
S-312
S-305
NAV. MC AND GLIDE SLOPE TUNING
NAV. KC ODD EVEN
S-309
S-313
NAV. MC GLIDE SLOPE AND LOC. ACTIVATE.
MC SHAFT
KC SHAFT
LOC. RELAY
P-301
SEE NOTE 9
13.75
27.5
13.75

[illegible] K OHM SHUNT RESISTOR

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
B.- ALL INDUCTORS ARE SHOWN IN MICRO-HENRIES UNLESS OTHERWISE NOTED.
C.- ALL RESISTORS ARE SHOWN IN ONE-HALF WATT UNLESS OTHERWISE NOTED.
D.- "K" DENOTES ONE THOUSAND. "M" DENOTES ONE MILLION.

NOTES:

1.- ALL RECEIVER VOLTAGES MEASURED WITH VOLUME CONTROLS FULL CCW, SQUELCH CONTROL FULL CW, NO SIGNAL INPUT AND 13.75 V. DC APPLIED TO UNIT.
2.- ALL TRANSMITTER VOLTAGES MEASURED WITH TRANSMITTER KEYED AND 13.75 V DC APPLIED TO UNIT.
3.- ALL RESISTANCES MEASURED TO CHASSIS (GND.) UNLESS OTHERWISE NOTED.
4.- MEASURED TO TERMINAL 14 OF P-101.
5.- MEASURED TO TERMINAL 6 OF P-101.
6.- MEASURED TO TERMINAL 15 OF P-101.
7.- MEASURED TO TERMINAL 8 OF P-101.
8.- MEASURED TO TERMINAL 7 OF P-101.
9.- TERMINALS 4, 5, 6, AND 7 ARE LOCATED ON THE 8 TERMINAL TIE LUG STRIP MOUNTED BENEATH THE VOLUME CONTROLS. VIEWED FROM FRONT, TERMINALS ARE NUMBERED FROM RIGHT TO LEFT.
10.- VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ±20% CAN BE EXPECTED.
11.- MEASURED THRU A 1 MEG. OHM RESISTOR.
12.- MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10 MC) VOLTMETER.
13.- VOLTAGE SHOWN ABOVE LINE - EXAMPLE $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$

Figure 11a.
SCHEMATIC, ***narco*** Mark-12, PANEL UNIT
For CN-89-B and CNP-89-B
T-02177A-Rev. V

Supplement No. 2
For CN89-C & D and CNP89-C & D
also CNPA89-B and CNPB89-B

narco MARK-12
VHF Transceiver

with
NAVIGATION RECEIVER
and
T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL
SUPPLEMENT No. 2.

for
CN89-C & D and CNP89-C & D Panel Units,
and
CNPA89-B and CNPB89-B Modulator-Power Units

NOTE:

This Supplement No. 2 provides revised schematics representing current production. The differences are of a minor nature, based on developments during successive production runs and on field experience.

A block diagram is provided for use with the Circuit Description and Maintenance Sections.

A complete new Replacement Parts List is provided.

Corrections:

Page 15, Column 2, under 4-D, paragraph 2, read: ....
105.55 Mc. .... and ....
first mixer, V-303.

Page 21, column 1, under 5-D,3.

Procedure:

In paragraph f., the second sentence should read "This voltage measured on *Pin 1*, V-204, should be approximately 8.5 volts RMS.

Page 36, Photo B, near the lower right side, the call-out L-306/C-306 should read L-306/*S-306*.

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

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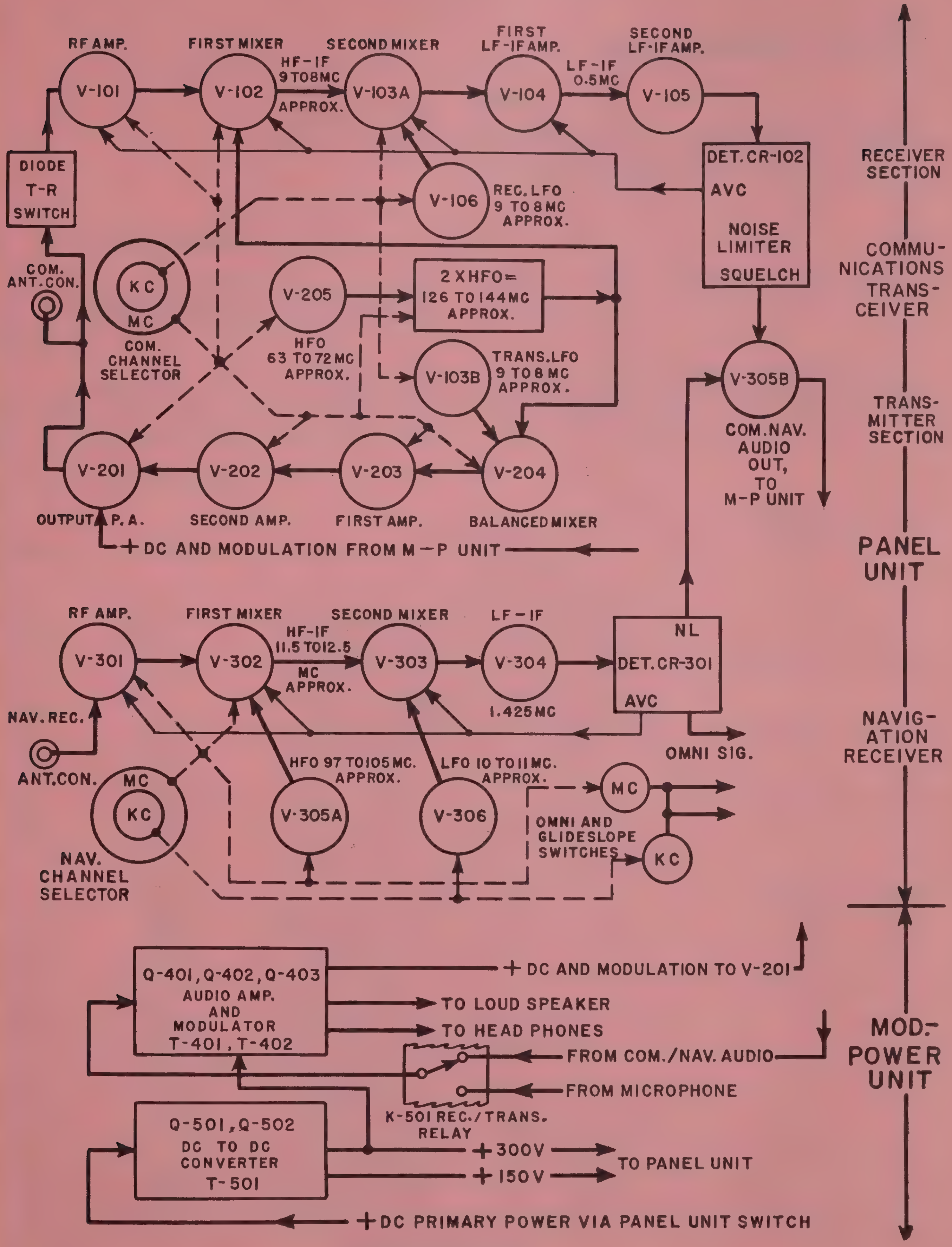
RF AMP.
V-101
FIRST MIXER
V-102
HF-IF 9 TO 8 MC APPROX.
SECOND MIXER
V-103A
FIRST LF-IF AMP.
V-104
LF-IF 0.5 MC
SECOND LF-IF AMP.
V-105
DIODE T-R SWITCH
COM. ANT. CON.
V-106
REC. LFO 9 TO 8 MC APPROX.
DET. CR-102
AVC
NOISE LIMITER
SQUELCH
KC
MC
COM. CHANNEL SELECTOR
V-205
HFO 63 TO 72 MC APPROX.
2 X HFO = 126 TO 144 MC APPROX.
V-103B
TRANS. LFO 9 TO 8 MC APPROX.
V-305B
COM. NAV. AUDIO OUT, TO M-P UNIT
V-201
V-202
V-203
V-204
OUTPUT P. A.
SECOND AMP.
FIRST AMP.
BALANCED MIXER
+ DC AND MODULATION FROM M-P UNIT
RECEIVER SECTION
COMMUNICATIONS TRANSCEIVER
TRANSMITTER SECTION
PANEL UNIT
RF AMP.
V-301
FIRST MIXER
V-302
HF-IF 11.5 TO 12.5 MC APPROX.
SECOND MIXER
V-303
LF-IF
V-304
1.425 MC
NL
DET. CR-301
AVC
OMNI SIG.
NAV. REC.
ANT. CON.
MC
KC
NAV. CHANNEL SELECTOR
HFO 97 TO 105 MC. APPROX.
V-305A
LFO 10 TO 11 MC. APPROX.
V-306
MC
KC
OMNI AND GLIDESLOPE SWITCHES
NAVIGATION RECEIVER
Q-401, Q-402, Q-403
AUDIO AMP. AND MODULATOR
T-401, T-402
+ DC AND MODULATION TO V-201
TO LOUD SPEAKER
TO HEAD PHONES
FROM COM./NAV. AUDIO
FROM MICROPHONE
K-501 REC./TRANS. RELAY
Q-501, Q-502
DC TO DC CONVERTER
T-501
+300V
+150V
TO PANEL UNIT
+DC PRIMARY POWER VIA PANEL UNIT SWITCH
MOD-POWER UNIT

BLOCK DIAGRAM
narco Mark-12 COMMUNICATIONS TRANSCEIVER

REPLACEMENT PARTS

NOTE:

This Supplement No. 2, Replacement Parts List is a complete integrated list for all Panel Units (CN89-A thru D and CNP89-A thru D) and all Modulator-Power Units (CNPA89-A & B and CNPB89 A & B).

A. INTRODUCTION.

This list of Replacement Parts contains the items that may be considered replaceable in the field. They should preferably be ordered by Symbol No., Part No., and Description.

The Replacement Parts are listed by their Symbol letter and number, alphabetically then numerically. Some items without a Symbol No., are listed numerically by Part Number in a "Miscellaneous" List following the listings by Symbol numbers. A few items without a Symbol No. may be listed with associatd parts such as connectors.

The "Function or Application" column is intended to separate the description of the item from its purpose in the equipment. It may also be found useful when working with the Illustrations and Schematics.

B. LIST OF PARTS.

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS	
C-101	21201-220	Ceramic Tubular, 500V, 22 micromicrofarads, ±10%	
C-102	21291-15	Ceramic Disc, 500V, .002 microfarads, ±10%	
C-103	21298-1	Feed-Thru, 500V, .001 microfarad, +100% −0%	
C-104	22019-2	Variable Plunger, 500V, 1.5 − 12.5 micromicrofarads	
C-105	21298-1	Same as C-103	COM RCVR RF Input
C-106	21291-21	Ceramic Disc., 1000V., .001 microfarad, ±20%	
C-107	21384-750	Ceramic Tubular, 500V, 75 micromicrofarads, ±5%	
C-108	24516-229	Ceramic Disc., 500V, 2.2 micromicrofarads, ±0.25	
C-109	22019-1	Variable Plunger, 500V, 0.5 − 4.5 micromicrofarads	COM RCVR RF Output
C-110	21291-21	Same as C-106	
C-111	24509-338	Ceramic, 500V., .33 micromicrofarads, ±5%	
C-112	22019-2	Same as C-104	
C-113	24502-109	Ceramic, 500V., 1.0 micromicrofarads, ±5%	COM RCVR First Mixer Input
C-114	21291-21	Same as C-106	
C-115	21291-4	Ceramic Disc, 500V, .003 microfarad, ±80% −20%	
C-116	24516-689	Ceramic Disc, 500V., 6.8 micromicrofarads ±0.5 micromicrofarads	
C-117	22019-1	Same as C-109	COM RCVR First Mixer Output
C-118	22019-1	Same as C-109	COM RCVR HF IF
C-119	21291-9	Ceramic Disc, 500V., .003 microfarad, ±10%	
C-120	21201-220	Same as C-101	
C-121	24516-229	Same as C-108	
C-122	22019-1	Same as C-109	COM RCVR Second Mixer Input
C-123	21291-21	Same as C-106	
C-124	23085-71	Mylar, 100V., .047 microfarad, ±10%	
C-125	23085-171	Mylar, 200V., .047 microfarad, ±10%	
C-126	23085-71	Same as C-124	
C-127	23085-171	Same as C-125	
C-128	23085-71	Same as C-124	
C-129	23085-171	Same as C-125	
C-130	21291-11	Ceramic Disc, 500V., 200 micromicrofarads, ±10%	
C-131	21291-11	Same as C-130	
C-132	23085-75	Mylar, 100V, 0.1 microfarad, ±10%	
C-133	23085-71	Same as C-124	
C-134	21298-1	Same as C-103	
C-135	21291-6	Ceramic Disc, 500V., 0.01 microfarad, GMV	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS, (Continued)	
C-136	24049-180	Dipped Mica, 500V., 18 micromicrofarads, ±5%	
C-137	24049-120	Dipped Mica, 500V., 12 micromicrofarads, ±1.0 micromicrofarads	
C-138	24049-750	Dipped Mica, 500 V., 75 micromicrofarads, ±5%	
C-139	23085-113	Mylar, 200V., .01 microfarad, ±20%	
C-140	21291-21	Same as C-106	
C-141	21291-21	Same as C-106	
C-142	21291-21	Same as C-106	
C-143	21291-21	Same as C-106	
C-144	21298-1	Same as C-103	
C-145	21291-21	Same as C-106	
C-146	21291-21	Same as C-106	
C-147	21291-21	Same as C-106	
C-148	24516-150	Ceramic Disc, 15 micromicrofarads, ±10%	
C-149	21291-21	Same as C-106	
C-150	21298-1	Same as C-103	
C-151	21291-6	Same as C-135	
C-152	21291-5	Ceramic Disc, 50 V., .01 mf, +80% −30%	
C-153	21291-5	Same as C-152	
C-154	21291-21	Same as C-106	
C-155	21291-21	Same as C-106	
C-156	21291-21	Same as C-106	
C-157	21291-21	Same as C-106	
C-158	24516-339	Ceramic Disc, 500V., 3.3 micromicrofarads, ±10%	
C-159	23085-113	Same as C-139	
C-160	23085-125	Mylar, 200V, 0.1 µfd, ±20%	CN-89-B,-C,-D. CNP-89-B,-C,-D
C-161	23085-151	Mylar, Tubular, 200V, .001 mfd, ±10%	CN-89-B,-C,-D CNP-89-B,-C, -D.
C-201	21201-220	Same as C-101	CN-89-C,-D. CNP-89-C,-D.
C-202	21291-21	Same as C-106	
C-203	21384-750	Same as C-107	
C-204	22019-1	Same as C-109	XMTR PA Output
C-205	21201-229	Ceramic Tubular, 500V, 2.2 micromicrofarads, 0.25 micromicrofarads	
C-206	21298-1	Same as C-103	
C-207	21291-21	Same as C-106	
C-208	21291-21	Same as C-106	
C-209	21298-1	Same as C-103	
C-210	21383-750	Ceramic Tub., 500V., 75 micromicrofarads, ±5%	
C-211	21201-150	Ceramic Tub., 500V., 15 mmf, ±10%	
C-212	21298-1	Same as C-103	
C-213	22019-1	Same as C-109	XMTR Buffer Output
C-214	21291-21	Same as C-106	
C-215	21291-21	Same as C-106	
C-216	21291-21	Same as C-106	
C-217	21383-750	Same as C-210	
C-218	21201-270	Ceramic Tub., 500V., 27 mmf, ±10%	
C-219	21298-1	Same as C-103	
C-220	21298-1	Same as C-103	
C-221	22019-1	Same as C-109	XMTR RF Amp. Output
C-222	21201-150	Same as C-211	
C-223	21291-21	Same as C-106	
C-224	21291-21	Same as C-106	
C-225	21201-479	Ceramic Tub., 500 V., 4.7 mmf, ±0.5 micromicrofarads	
C-226	21291-14	Ceramic Disc, 500V., 100 mmf, ±10%	
C-227	21298-1	Same as C-103	
C-228	22029-1	Split Stator Glass, 500V., 0.5 to 2.5 micromicrofarads	XMTR Mixer
C-229	21291-14	Same as C-226	
C-230	21291-21	Same as C-106	
C-231	21291-21	Same as C-106	
C-232	21298-1	Same as C-103	
C-233	24516-229	Same as C-108	
C-234	24516-229	Same as C-108	
C-235	21298-1	Same as C-103	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS, (Continued)	
C-236	21291-21	Same as C-106	
C-237	22019-1	Same as C-109	COM TCVR HFO/Doubler Output
C-238	24049-330	Dipped Mica, 500V., 33 micromicrofarads, ±5%	
C-239	24049-750	Same as C-138	
C-240	21201-759	Ceramic Tub., 500V., 7.5 micromicrofarads, ±0.5 micromicrofarad	
C-241	22019-1	Same as C-109	COM TCVR HFO/Doubler Input
C-242	24049-120	Same as C-137	
C-243	24049-750	Same as C-138	
C-244	21291-6	Same as C-135	
C-245	24049-220	Dipped Mica, 500V., 22 micromicrofarads, ±5%	
C-246	21291-21	Same as C-106	
C-247	21291-21	Same as C-106	
C-248	21298-1	Same as C-103	
C-249	21298-1	Same as C-103	
C-250	21291-19	Ceramic Disc, 500V., 1K micromicrofarad, ±10%	
C-251	21291-21	Same as C-106	
C-252	21291-21	Same as C-106	
C-253	21201-100	Ceramic Tub., 500 V., 10 micromicrofarads, ±1.0 micromicrofarads	
C-254	21291-21	Same as C-106	
C-255	21291-21	Same as C-106	
C-256	21291-21	Same as C-106	
C-257	21298-1	Same as C-103	
C-258	21291-21	Same as C-106	
C-259		Not Used	
C-260	21291-21	Same as C-106	
C-261	21291-6	Same as C-135	
C-262	21298-1	Same as C-103	
C-263	21291-21	Same as C-106	
C-264	24516-229	Same as C-108	
C-265	24516-229	Same as C-108	
C-266	21291-21	Same as C-106	CN-89-A,-B, CNP-89-A,-B.
C-266	21291-5	Same as C-152	CN-89-C,-D CNP-89-C,-D.
C-267	21291-21	Same as C-106	
C-268	21298-1	Same as C-103	
C-301	21201-100	Same as C-253	Early Production
C-301	21201-829	Ceramic Tub., 500V., 8.2μμf, ±0.5μμf, NPO.	Later Production
C-302	21291-21	Same as C-106	
C-303	21201-100	Same as C-253	
C-304	21291-21	Same As C-106	
C-305	24516-689	Same as C-116	
C-306	22019-1	Same as C-109	NAV RCVR RF Output
C-307	24509-688	Ceramic, 500V., 68 micromicrofarads, ±5%	
C-308	22019-1	Same as C-109	NAV RCVR First Mixer Input
C-309	24516-689	Same as C-116	
C-310	24509-828	Ceramic, 500V., .82 micromicrofarads, ±5%	
C-311	21219-18	Ceramic Disc. 500V., 330 micromicrofarads, ±10%	
C-312	21291-4	Same as C-115	
C-313	21291-21	Same as C-106	
C-314	22019-1	Same as C-109	NAV RCVR First Mixer Output
C-315	21201-229	Same as C-205	
C-316	21291-6	Same as C-135	
C-317	23085-113	Same as C-139	
C-318	22001-312	Ceramic Trimmer, 350V., 3-12 mmf, NPO	NAV Second Mixer Input
C-319	21282-2	Ceramic Tub., 500V., 7.5 micromicrofarads, ±0.5%	
C-320	23085-71	Same as C-124	
C-321	21291-4	Same as C-115	
C-322	21207-120	Ceramic Tub., 12 micromicrofarads, ±10%, N-750	
C-323	21207-120	Same as C-322	
C-324	23085-71	Same as C-124	
C-325	21207-120	Same as C-322	

C, CAPACITORS (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
C-326	21291-4	Same as C-115	
C-327	23085-79	Mylar, 100V., 22 microfarad, ± 10%	
C-328	21207-120	Same as C-322	
C-329	21291-14	Same as C-226	
C-330	21291-14	Same as C-226	
C-331	23085-79	Same as C-327	
C-332	23085-79	Same as C-327	
C-333	24049-150	Dipped Mica, 500 V., 15 micromicrofarads, ± 1.0 micromicrofarad	
C-334	24049-750	Same as C-327	
C-335	22019-1	Same as C-109	NAV RCVR HFO Output
C-336	21291-21	Same as C-106	
C-337	21298-1	Same as C-103	
C-338	21298-1	Same as C-103	
C-339	21291-6	Same as C-135	
C-340	21299-470	Ceramic Tub., 500V., 47 micromicrofarads, ± 10%	
C-341	24049-431	Dipped Mica, 500V., 15 micromicrofarads, ± 1.0 micromicrofarad	
C-342	24045-122	Dipped Mica, 500V., 1200 micromicrofarads	
C-343	21206-330	Ceramic Tub., 500V., 33 μμf, ± 10%, N-470	CN-89-A,-B CNP-89-A,-B
C-343	21294-330	Ceramic Tub., 500V., 33μμf, ± 10% N-1500	CN-89-C,-D CNP-89-C,-D
C-344	24517-1	Feed Thru, 500V., 100 micromicrofarads, ± 10%	
C-345	22001-312	Same as C-318	
C-346	21201-330	Ceramic Tub., 500 V., 33μμf, ± 10%	
C-346	21201-Sel.	Ceramic Tub., 500V., 33 or 47 micromicrofarads, ± 10%	
C-347	21291-21	Same as C-106	
C-348	21291-21	Same as C-106	CN-89-A CNP-89-A
C-348	23085-151	Same as C-161	CN-89-B,-C,-D CNP-89-B,-C,-D
C-349	21291-21	Same as C-106	
C-350	21298-1	Same as C-103	
C-351	21298-1	Same as C-103	
C-352	21291-21	Same as C-106	
C-353	21298-1	Same as C-103	
C-354	21291-21	Same as C-106	
C-355	21291-21	Same as C-106	
C-356	21291-5	Same as C-152	
C-357	21291-21	Same as C-106	
C-358	21291-21	Same as C-106	
C-359	21282-2	Same as C-319	
C-360	21291-21	Same as C-106	
C-361	21291-21	Same as C-106	
C-362	24516-150	Same as C-148	
C-363	21291-7	Ceramic Disc, 1000V., 470μμf, ± 20%	CN-89-C,-D CNP-89-C,-D
C-364	21291-21	Same as C-106	CN-89-C,-D CNP-89-C,-D
C-401	21552-16	Electrolytic, 3V., 150 microfarads, + 150% − 10%	
C-402	21552-17	Electrolytic, 15V., 500 microfarads, Min. Tol.	
C-403	23085-113	Same as C-139	
C-404	21552-3	Electrolytic, 35V., 20 mf, + 150% − 10%	
C-405	21291-22	Ceramic Disc, 500V., .005 mf, ± 10%	
C-406	21552-18	Electrolytic, 15 forward, 5 reverse, 30 mfd, + 150% − 10%	
C-501	23085-25	Mylar, 100V., 0.1μf, ± 20%	
C-502	21525-23	Electrolytic, 400V., −50 mf, 200V. −100 mf, 200V. −20 mf	
C-503	21291-23	Ceramic Disc, 500V., .004 mf, ± 10%	24 V. Operation
C-503	21291-22	Same as C-405	12 V. Operation
C-504	21291-22	Same as C-503	12 V. Operation
C-504	21291-23	Same as C-503	24 V. Operation
C-505	23085-87	Mylar, 100V., 1.0 mf, ± 10%	
C-506	21525-25	Electrolytic, 35V., 500 mf	
C-507	23085-25	Same as C-501	CNPA-89-B CNPB-89-B
C-508	23085-25	Same as C-501	CNPA-89-B CNPB-89-B

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		CR, DIODES	
CR-101	75013-5	Diode, Silicon, CD12227 (Similar to 1N459)	CN-89-A,-B,-C,-D CNP-89-A,-B,-C,-D
CR-102	75019-1	Diode, Silicon, 1N914	CN-89-A, CNP-89-A CN-89-B CNP-89-B Early Production
CR-102	75019-2	Diode, Silicon, CD6487	CN-89-A, CNP-89-A CN-89-B, CNP-89-B Later Production
CR-103	75013-4	Diode, Silicon, CD12226 (Similar to 1N457)	CN-89-A,-B,-C,-D CNP-89-A,-B,-C,-D
CR-104	74013-4	Same as CR-103	CN-89-B,-C,-D CNP-89-B,-C,-D
CR-201	75019-2	Same as CR-102	Later Production
CR-301	75019-1	Same as CR-102	NAV RCVR
CR-302	75013-4	Same as CR-103	NAV RCVR
CR-303	75013-4	Same as CR-103	NAV RCVR
CR-501	75204-5	Diode, Silicon, 500 PIV	MOD-PWR Unit
CR-502	75204-5	Same as CR-501	MOD-PWR Unit
CR-503	75204-5	Same as CR-501	MOD-PWR Unit
CR-504	75204-5	Same as CR-501	MOD-PWR Unit
CR-505	75204-5	Same as CR-501	MOD-PWR Unit
CR-506	75204-5	Same as CR-501	MOD-PWR Unit
		F, FUSES	
F-501	66504-12	Fuse, 10A, Slow-Acting Type	12V. MOD-PWR Unit
F-501	66504-10	Fuse, 6-1/4A, Slow-Acting Type	24V. MOD-PWR Unit
		I, LAMPS	
I-101		Lamp No. 53 Red	Panel Illumination
I-102		Lamp, Same as I-101	Panel Illumination
		J, JACKS (CONNECTORS)	
J-101	41110-2	Connector, Chassis, Female	Com. Ant., Panel Unit
J-301	41143-1	Connector, Chassis, Female	Nav. Ant., Panel Unit
J-501	41181-4	Connector, 16 Pin	Power, MP Unit
		K, RELAYS	
K-501	65126-20	Relay, 5 Form C Contacts	T-R Transfer MOD-PWR Unit
		L, INDUCTORS	
L-101	11135-9	Choke	RF Antenna Filter
L-102	11273-26	Coil, Ant. Com. Rec.	
L-103	61378-101	Step Inductor	
L-104	11412-123	Coil, RF Plate, Com.	
L-105	61378-101	Same as L-103	
L-106	11412-129	Coil, Mixer, Comm.	
L-107	61378-101	Same as L-103	
L-108	61406-1	Step Inductor	HF IF COM
L-109	61406-1	Same as L-108	
L-110	61406-1	Same as L-108	
L-111	11138-22	Choke, RF, 18 microhenries, ± 10%	
L-112	11135-9	Same as L-101	
L-113	11138-19	Choke, RF, 15 microhenries, ± 10%, Insulated	
L-114	11138-9	Choke, RF, 2.2 microhenries	
L-201	61378-101	Same as L-103	
L-202	11627-1	Coil, Final Tank	
L-203	11138-9	Same as L-114	
L-204	11138-8	Choke, RF, 1.5 microhenry, ± 20%	
L-205	61378-101	Same as L-103	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		L, INDUCTORS (CONTINUED)	
L-206	11138-9	Same as L-203	
L-207	11412-133	Coil, Second Buffer	
L-208	11138-8	Same as L-204	
L-209	61378-101	Same as L-103	
L-210	11138-11	Choke, RF, 3.3 microhenries, ± 10%	
L-211	11412-134	Coil, First Buffer	
L-212	61378-101	Same as L-103	
L-213	11138-4	Choke, RF, 0.33 microhenry, ± 20%	
L-214	11412-135	Coil, Mixer	
L-215	11412-132	Coil, Doubler	
L-216	61393-101	Step Inductor Doubler	
L-217	11138-5	Choke, RF, 0.47 microhenry, ± 10%	
L-218	11412-112	Coil, HFO	
L-219	61393-101	Same as L-216	
L-220	11138-22	Same as L-111	
L-221	11138-5	Same as L-217	
L-222	11138-5	Same as L-217	
L-223	11138-5	Same as L-217	
L-224	11138-5	Same as L-217	
L-225	11138-5	Same as L-217	CN-89-C,-D CNP-89-C,-D
L-226	11138-5	Same as L-217	CN-89-C,-D CNP-89-C,-D
L-227	11138-4	Same as L-213	
L-301	11273-22	Coil, RF	
L-302	61386-1	Step Inductor	
L-303	11138-27	Choke, RF, 0.09 microhenry, ± 10%	
L-304	61386-1	Same as L-302	
L-305	11138-27	Same as L-303	
L-306	61386-1	Same as L-302	
L-307	61407-1	Step Inductor, HF IF	
L-308	61407-1	Same as L-307	
L-309	11412-131	Coil, HFO	
L-310	61386-1	Same as L-302	
L-311	11138-2	Choke, RF, 0.15 microhenry, ± 20%	
L-312	11359-20	Choke, RF, 39 microhenries, ± 10%	
L-313	11138-28	Choke, RF, 0.49 μh., ± 5%	CN-89-A,-B CNP-89-A,-B
L-313	11138-5	Choke, RF, insulated, 0.47 μh, ± 20%	CN-89-C,-D CNP-89-C,-D
L-314	11273-21	Coil, LFO	
L-315	61384-1	Step Inductor, LFO	
L-316	11138-5	Same as L-217	
L-317	11135-9	Same as L-101	
L-401	11814-2	Inductor, Filter	
L-501	11176-3	Choke, 50 microhenries	
		P, PLUGS (CONNECTORS)	
P-101	41181-3	Connector, 16 Pin Male	Power Circuits, Panel Unit Cable Assy.
	41182-2	Cap, Connector, for P-102 and P-501	Power Circuits, Panel Unit Cable Assy.
P-102	41271-1	Connector, 16 Pin Female	Panel to MP Unit Cable
P-301	41117-1	Connector, 6 Pin Female	Omni Circuits, Panel Unit Cable Ass
	41130-1	Connector, Male	COM Ant.
	41237-1	Connector, Male	NAV Ant. Cable
	41237-2	Ferrule, for 41237-1	NAV Ant. Cable
P-501	41271-1	Same as P-102	Same as P-102
		Q, TRANSISTORS	
Q-401	75510-2	Transistor, Audio Driver	Early Production
Q-401	75534-4	Transistor, Audio Driver	Later Production
Q-402	75510-4	Transistor, Audio Output	24V. Mod-Pwr Unit Early Production

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
Q-402	75534-3	Transistor, Audio Output	24 V. Mod-Pwr Unit Later Production
Q-403	75510-4	Same as Q-402	12V. Mod-Pwr Unit Early Production
Q-403	75534-3	Same as Q-402	12V. Mod-Pwr Unit Later Production
Q-501	75504-1	Transistor, DC Power, 2N441	12V. Mod-Pwr Unit
Q-501	75505-3	Transistor, DC Power, 2N174	24 V. Mod-Pwr Unit
Q-502	75504-1	Same as Q-501	12V Mod-Pwr Unit
Q-502	75505-3	Same as Q-501	24 V. Mod-Pwr Unit
		R, RESISTORS	
R-101	31141-103	Carbon, ½ W, 10K ohms, ± 10%	
R-102	31141-473	Carbon, ½ W, 47K ohms, ± 10%	
R-103	31141-221	Carbon, ½ W, 220 ohms, ± 10%	
R-104	31141-104	Carbon, ½ W, 100K ohms, ± 10%	
R-105	31141-104	Same as R-104	
R-106	31141-151	Carbon, ½ W, 150 ohms, ± 10%	
R-107	31141-821	Carbon, ½ W, 820 ohms, ± 10%	
R-108	31141-104	Same as R-104	
R-109	31141-151	Same as R-106	
R-110	31141-102	Carbon, ½ W, 1K ohms, ± 10%	
R-111	31141-151	Same as R-106	
R-112	31141-104	Same as R-104	
R-113	31141-122	Carbon, ½ W, 1.2K ohms, ± 10%	CNP-89-A
R-113	31141-471	Carbon, ½ W, 470 ohms, ± 10%	CN-89-A, CN-89-B-C-D CNP-89-B-C-D
R-114	31141-151	Same as R-106	
R-115	31141-821	Same as R-107	CNP-89-A
R-115	31141-471	Same as R-113 for CN-89, -A, CN-89-B, CNP-89-B.	CNP-89-A, CN-89-B,-C-D. CNP-89-B,-C,-D.
R-116	31141-102	Same as R-110	
R-117	31141-154	Carbon, ½ W, 150K ohms, ± 10%	
R-118	31141-103	Same as R-101	
R-119	31141-474	Carbon, ½ W, 470K ohms ± 10%	
R-120	31141-102	Same as R-110	CN-89-A, CNP-89-A
R-120	31141-561	Carbon, ½ W, 560 ohms, ± 10%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-121	31141-124	Carbon, ½ W, 120 K ohms, ± 10%	
R-122	32040-1	Potentiometer, ½ W, 1 Megohm	CN-89-A, CNP-89-A Volume Control
R-122	32033-1	Potentiometer, ½ W, 1 Megohm	CN-89-B,-C,-D CNP-89-B,-C,-D Volume Control
R-123	31141-823	Carbon, ½ W, 82K ohms, ± 10%	
R-124	31141-151	Same as R-106	
R-125	31141-470	Carbon, ½ W, 47 ohms, ± 10%	
R-126	31141-103	Same as R-101	
R-127	31141-105	Carbon, ½ W, 1 Megohm, ± 10%	
R-128	31141-471	Same as R-305	
R-129	31135-333	Carbon, 1 W, 33 K ohms, ± 10%	
R-130	31141-473	Same as R-102	
R-131	31141-104	Same as R-104	
R-132	31141-100	Carbon, ½ W, 10 ohms, ± 10%	
R-133	31141-222	Carbon, ½ W, 2.2K ohms, ± 10%	CNP-89-A
R-134	31141-473	Same as R-102	CN-89-B,-C,-D CNP-89-B,-C,-D
R-135	31141-395	Carbon, ½ W, 3.9 Megohms, ± 10%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-136	31149-333	Carbon, ½ W, 33K ohms, ± 5%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-137	31141-395	Same as R-135	CN-89-B,.C,-D CNP-89-B,-C,-D
R-138	32033-1	Part of R-122 Assembly, Pot. 50K ohms	CN-89-B,-C,-D CNP-89-B,-C,-D Squelch Control
R-139	31149-104	Carbon, ½ W, 100K ohms, ± 5%	CN-89-B,-C,-D CNP-89-B,-C,-D
R-201	31141-104	Same as R-104	
R-202	31135-472	Carbon, 1 W, 4.7K ohms, ± 10%	
R-203	31161-8	Wire-wound, 3 W, 200 ohms, ± 5%	
R-204	31141-683	Carbon, ½ W, 68K ohms, ± 10%	
R-205	31141-333	Carbon, ½ W, 33K ohms, ± 10%	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		R,RESISTORS (CONTINUED)	
R-206	31135-103	Carbon, 1 W, 10K ohms, ± 10%	
R-207	31141-101	Carbon, ½ W, 100 ohms, ± 10%	
R-208	31135-221	Carbon, 1 W, 220 ohms, ± 10%	
R-209	31141-223	Carbon, ½ W, 22K ohms, ± 10%	
R-210	31135-103	Same as R-206	
R-211	31141-101	Same as R-207	
R-212	31141-104	Same as R-104	
R-213	31141-104	Same as R-104	
R-214	31141-101	Same as R-207	
R-215	31141-103	Same as R-101	
R-216	31141-472	Carbon, ½ W, 4.7K ohms, ± 10%	
R-217	31141-152	Carbon, ½ W, 1.5K ohms, ± 10%	
R-218	31141-473	Same as R-102	
R-219	31141-474	Same as R-119	
R-220	31141-391	Carbon, ½ W, 390 ohms, ± 10%	
R-221	31141-104	Same as R-104	
R-222	31135-471	Carbon, 1 W, 470 ohms, ± 10%	
R-223	31141-104	Same as R-104	
R-224	31135-333	Same as R-129	CN-89-C,-D CNP-89-C,-D
R-225	31141-223	Same as R-209	
R-226	31141-470	Same as R-125	
R-227	31141-470	Same as R-125	
R-228	31141-479	Carbon, ½ W, 4.7 ohms, ± 10%	
R-301	31141-221	Same as R-103	
R-302	31141-104	Same as R-104	
R-303	31141-151	Same as R-106	
R-304	31141-104	Same as R-104	
R-305	31141-471	Carbon, ½ W, 470 ohms, ± 10%	
R-306	31141-151	Same as R-106	
R-307	31141-104	Same as R-104	
R-308	31141-471	Same as R-305	
R-309	31141-151	Same as R-106	
R-310	31141-141	Same as R-106	
R-311	31141-102	Same as R-110	
R-312	31141-685	Carbon, ½ W, 6.8 Megohms, ± 10%	
R-313	31141-151	Same as R-106	
R-314	31141-474	Same as R-119	
R-315	31141-474	Same as R-119	
R-316	31141-103	Same as R-101	
R-317	31141-184	Carbon, ½ W, 180K ohms, ± 10%	
R-318	32040-2	Potentiometer, ½ W, 1 Meg. ± 5%	Volume Control
R-319	31141-105	Same as R-127	
R-320	31141-105	Same as R-127	
R-321	31141-182	Carbon, ½ W, 1.8K ohms, ± 10%	
R-322	31141-152	Same as R-217	
R-323	31141-473	Same as R-102	
R-324	31141-479	Same as R-228	
R-325	31141-224	Carbon, ½ W, 220K ohms, ± 10%	
R-326	31141-332	Carbon, ½ W, 3.3K ohms, ± 10%	
R-327	31135-153	Carbon, 1 W, 15K ohms, ± 10%	
R-328	31141-153	Carbon, ½ W, 15K ohms, ± 10%	
R-329	31141-102	Same as R-110	
R-330	31141-105	Same as R-127	
R-331	31141-151	Same as R-106	
R-332	31141-473	Same as R-102	
R-333	31141-154	Same as R-117	
R-334	31141-105	Same as R-127	
R-401	31141-821	Same as R-107	
R-402	31141-681	Carbon, ½ W, 680 ohms, ± 10%	Early Production
R-402	31141-471	Same as R-113 for CN-89A, CN-89B, CNP-89-B	Later Production
R-403	31179-1	Temp. Sensitive, 0.47 ohm, ± 10% + TC	
R-404	31141-471	Same as R-113	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		R, RESISTORS (CONTINUED)	
R-405	31136-270	Carbon, 2W, 27 ohms, ± 10%	
R-406	31135-221	Carbon, 1 W, 220 ohms, ± 10%	12V. Unit
R-406	31135-681	Carbon, 1 W, 680 ohms, ± 10%	24V. Unit
R-407	31141-151	Same as R-106	12V. Unit
R-407	31141-221	Same as R-103	24 Volt Unit
R-408	31141-822	Carbon, ½ W, 8.2K ohms, ± 10%	
R-409	31175-11	Wirewound, 5W, 75 ohms, ± 5%	
R-410	31141-331	Carbon, ½ W, 330 ohms, ± 10%	CN-89-C,-D CNP-89-C,-D
R-501	31141-180	Carbon, ½ W. 18 ohm, ± 10%	12V MOD-PWR Unit
R-501	31141-101	Same as R-207	24V MOD-PWR Unit
R-502	31136-331	Carbon, 2W, 330 ohm, ± 10%	12V MOD-PWR Unit
R-502	31136-102	Carbon, 2W, 1K ohms, ± 10%	24V MOD-PWR Unit
R-503	31136-331	Same as R-503	12V MOD-PWR Unit
R-503	31136-102	Same as R-502	24V MOD-PWR Unit
R-504	31141-180	Same as R-501	12V MOD-PWR Unit
R-504	31141-101	Same as R-501	24V MOD-PWR Unit
R-505	31135-274	Carbon, 1W, 270K ohms, ± 10%	
R-506	31136-101	Carbon, 2W, 100 ohms, ± 10%	
R-507	31175-11	Same as R-409	
R-508	31141-220	Carbon, ½ W, 22 ohm, ± 10%	For CN-89-A,-B CNP-89-A,-B
R-508	31141-330	Carbon, ½ W, 33 ohms, ± 10%	For CN-89-C-D CNP-89-C-D
R-509	31141-220	Same as R-508 for CN-89-A,-B	
R-510	31141-220	Same as R-508 for CN-89-A,-B	
		S, SWITCHES	
S-101	32040-1	Switch, Part of Assembly R-122	CN-89-A, CNP-89-A +DC On-Off
S-101	32033-1	Switch, Part of Assembly R-122	CN-89-B,-C,-D CNP-89-B,-C,-D +DC On-Off
S-102	32040-1	Switch, Part of Assembly R-122	CN-89-A, CNP-89-A Speaker Ground
S-102	32033-1	Switch, Part of Assembly R-122	CN-89-B,-C,-D CNP-89-B,-C,-D Speaker Ground
S-103	61378-101	Switch, Part of L-103	COM RCVR RF Input
S-104	61409-101	Switch, Assembly	XTAL Sel., Kc
S-105	61378-101	Switch, Part Of L-105	COM RCVR RF Output
S-106		Not Used	
S-107	61378-101	Part of L-107	COM RCVR RF Input
S-108	61406-1	Part of L-108	
S-109	61406-1	Part of L-109	
S-110	61406-1	Part of L-110	
S-201	61378-101	Part of L-201	
S-202	61395-1	Switch, XTAL, HFO	COM (Front)
S-203	61396-1	Switch, XTAL, HFO	COM (Rear)
S-204	61391-101	Switch, Part of S-104	
S-205	61378-101	Switch, Part of L-205	
S-206		Not Used	
S-207		Not Used	
S-208		Not Used	
S-209	61378-101	Switch, Part of L-209	
S-210		Not Used	
S-211		Not Used	
S-212	61378-101	Switch, Part of L-212	
S-213		Not Used	
S-214		Not Used	
S-215		Not Used	
S-216	61393-101	Switch, Part of L-216	
S-217		Not Used	
S-218		Not Used	
S-219	61393-101	Switch, Part of L-219	
S-220		Not Used	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		S, SWITCHES (CONTINUED)	
S-301	61389-1	Switch, XTAL, HFO NAV.	
S-302	61386-1	Switch, Part of L-302	
S-303	61389-1	Same as S-301	
S-304	61386-1	Switch, Part of L-304	
S-305	61388-1	Switch, G/S	
S-306	61386-1	Switch, Part of L-306	
S-307	61407-1	Switch, Part of L-307	
S-308	61407-1	Switch, Part of L-308	
S-309	61385-1	Switch, G/S	
S-310	61386-1	Switch, Part of L-310	
S-311	61387-1	Switch, G/S	
S-312	61387-1	Same as S-311	
S-313	61387-1	Same as S-311	
S-314		Not Used	
S-315	61384-1	Switch, Part of L-315	
		T, TRANSFORMERS	
T-101	11816-102	Transformer, Com RCVR	HF IF Input
T-102	11817-102	Transformer, Com, RCVR	HF IF Input
T-103	11819-102	Transformer, Com. RCVR	LF IF Input & Interstage
T-104	11819-102	Same as T-103	LF IF Output
T-105	11820-102	Transformer, Com	
T-301	11818-102	Transformer, NAV.	HF IF
T-302	11815-102	Transformer, NAV.	LF IF Input
T-303	11822-102	Transformer, NAV.	LF IF Output
T-401	11821-102	Transformer, Audio Driver	12V. and 24V. Units
T-402	11821-101	Transformer, Audio Output	12V. Unit
T-402	11633-101	Transformer, Audio Output	24V. Unit
T-501	11626-1	Transformer, Power 13.2V	12V. Unit
T-501	11629-1	Transformer, Power 27.5V	24V. Unit
		V, ELECTRON TUBES	
V-101	6BH6	Tube, Electron, Pentode	COM. RCVR RF
V-102	6AK5	Tube, Electron, Pentode	COM. First Mixer
V-103	6EA8	Tube, Electron, Triode Pentode	COM. Second Mixer and COM. Trans LFO
V-104	6BJ6	Tube, Electron, Pentode	COM. First LF IF
V-105	6BJ6	Same as V-104	COM. Second LF IF
V-106	6CW4	Tube, Electron, Triode (Nuvistor)	COM. RCVR LFO
V-201	7551	Tube, Electron, Pentode	Trans. P.A.
V-202	7551	Same as V-201	Trans, Buffer
V-203	8106	Tube, Electron, Tetrode	Trans, RF Amp.
V-204	6AR8	Tube, Electron, Sheet Beam	Trans, Mixer
V-205	7587	Tube, Electron, Tetrode (Nuvistor)	COM. Transceiver HFO/Doubler
V-301	6BH6	Same as V-101	NAV RF Amp.
V-302	6CB6	Tube, Electron, Pentode	NAV First Mixer
V-303	6CB6	Same as V-302	NAV Second Mixer
V-304	6BJ6	Same as V-104	NAV LF, IF
V-305	7898	Tube, Electron, Dual Triode	NAV HFO/Audio Cath. Follower
V-306	6CW4	Same as V-106	NAV LFO
		XT, CRYSTALS, QUARTZ, SUBMINIATURE	
XT-101	72007-121	63.2375 Mc, for 117 Whole Mc	COM. Transceiver
XT-102	72007-122	63.7375 Mc, for 118 Whole Mc	COM. Transceiver
XT-103	72007-123	64.2375 Mc. for 119 Whole Mc	COM. Transceiver
XT-104	72007-124	64.7375 Mc. for 120 Whole Mc	COM. Transceiver
XT-105	72007-125	65.2375 Mc. for 121 Whole Mc	COM. Transceiver

NOTE—This sheet may be
placed at the front
of the original
Manual MM-211,
with its Supplement
No. 1.

narco MARK-12
VHF Transceiver

with

NAVIGATION RECEIVER

and

T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL

for
CN89-A and CNP89-A Panel Units with
CNPA89-A and CNPB89-A Modulator-Power Units

With SUPPLEMENT No. 1, for CN89-B and CNP89-B Panel Units

And with SUPPLEMENT No. 2, for CN89-C & D and CNP89-C & D Panel Units,
and for CNPA89-B and CNPB89-B Modulator-Power Units

NATIONAL AERONAUTICAL CORPORATION
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May, 1964

NOTE—This sheet may be placed at the front of the original Manual MM-211.

narco MARK-12
VHF Transceiver

with

NAVIGATION RECEIVER

and

T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL

for

CN89-A and CNP89-A

with

CNPA89-A or CNPB89-A

and with

SUPPLEMENT No. 1

for

CN89-B and CNP89-B

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

Printed in U.S.A. MM-211 September, 1963

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MAINTENANCE MANUAL

CN89-A
CNP89-A
CNPA89-A
CNPB89-A

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

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SECTION 1
GENERAL INFORMATION

1-A. INTRODUCTION.

The ***narco*** MARK 12 Equipment comprises a VHF Communications Transceiver and a VHF Navigation Receiver in a panel-mounted unit, and a remote-mounted Modulator-Power Unit.

1-A,1. Panel Unit.

The VHF Transceiver is designed to be used as a primary communications apparatus. It is controlled by the left hand frequency selector of the Panel Unit. It is available with either 90 or 360 crystal controlled channels. A kit of crystals is obtainable from ***narco*** to enable a 90 channel MARK 12 to be converted to operate on all 360 channels at any later date. Single-channel-simplex (SCS) operation is provided as both receiver and transmitter are channeled by the same selector.

A 100 channel VHF Navigation Receiver is controlled by the right hand frequency selector, to provide Omni Range Navigation when used with the ***narco*** VOA-6 Omni Converter. When used with an omni converter such as the ***narco*** VOA-4 or VOA-5, complete VOR/LOC navigation reception is available.

Glide Slope channel selector switches are included as part of the Navigation Receiver. In order to make connection between these switches and any standard Glide Slope Receiver it is necessary to install a Cable and Connector Kit in the Navigation Receiver.

1-A,2. Modulator-Power Unit.

A remote-mounted Unit, the T12MP-12 or T24MP-12, contains the power supply and audio-modulator. An auxiliary audio input circuit is provided so that one or more other radio equipments may be connected to operate through the ***narco*** MARK-12 Audio Amplifier. This audio input circuit is designed for a level of 50 milliwatts from a 300 ohm source.

The T12MP-12 and T24MP-12 Units have been designed to be mounted either horizontally or vertically, by means of the mounting base supplied.

1-B. SPECIFICATIONS.

1-B,1. Communications Transceiver.

a. Frequency Range, Domestic Equipment.

90 Channel Equipment:
118.0 thru 126.9 megacycles.
(100 Kc Channel Spacing)

360 Channel Equipment:
118.00 thru 135.95 megacycles.
(50 Kc Channel Spacing)

b. Frequency Range, Export Equipment.

100 Channel Equipment:
117.0 thru 126.9 megacycles.
(100 Kc Channel Spacing)

380 Channel Equipment:
117.00 thru 135.95 megacycles.
(50 Kc Channel Spacing)

1-B,2. Communications Transmitter.

Power Output:
Nominal 8 to 10 watts.

Sidetone:
50 Milliwatts.

Modulation:
70% minimum, 85% before clipping.

Microphone:
Carbon, or noise-cancelling carbon (low impedance) type to be used.

Duty:
Maximum 20%.

1-B,3. Communications Receiver.

Sensitivity:
1.5 microvolts maximum for 6 db signal + noise to noise ratio.

Overall Selectivity:
6 db (nose),
32 Kc minimum bandwidth.
60 db (skirt), 90 Kc maximum bandwidth.

Image Rejection:
At least 60 db.

AVC:
4 db from 10 to 10,000 microvolts.

Audio Output:
6 to 8 watts.

1-B,4. Navigation Receiver.

Frequency Range:
108.0 thru 117.9 megacycles
(100 Kc Channel Spacing).

Sensitivity:
1.0 microvolt for 6 db signal + noise to noise ratio.

Overall Selectivity:
6 db (nose), 42 Kc minimum bandwidth.
60 db (skirt), 190 Kc maximum bandwidth.

Image Rejection:
At least 70 db.

AVC:
4 db from 10 to 10K microvolts.

Audio Output:
6 watts.

1-B,5. General.

a. Size:

Panel Unit: See Figure 9, page 36.
Modulator-Power Unit: See Figure 10, page 36.

b. Weight:

Panel Unit: 5.1 pounds.
Modulator-Power Unit: 3.9 pounds.

c. Power Required:

At 13.75 Volts, 5.2 amps Receive,
9.5 amps Transmit.

At 27.50 Volts, 2.7 amps Receive,
4.9 amps Transmit.

SECTION 2
INSTALLATION

2-A. INTRODUCTION.

The ***narco*** MARK-12 Equipment, except for Antennas and Accessories, is contained in a Panel Unit and a Modulator-Power Unit.

The Panel Unit is normally installed in or near the aircraft instrument panel, for convenient direct operation by the pilot. The Panel Unit Case is usually installed permanently. When this is done, the Panel Unit Assembly may be installed or removed by operating the "Airloc" fastener and attaching or detaching the cables, by means of the connectors provided, at the rear of the Assembly.

The Modulator-Power Unit may be installed in a convenient location at an interconnecting cable distance of up to 16 feet. It is well to avoid locations which are subject to extremes of temperature, dirt or moisture. The unit is provided with a mounting base. This base is usually installed permanently. The Modulator-Power Unit, with its cover intact, may then be installed or removed by tightening or loosening (without removing) the four mounting screws and connecting or disconnecting a single cable connector.

The Interconnecting Cable, with provision for accessory connections, may be purchased from ***narco*** in 8 or 16 foot lengths or may be fabricated to suit the particular installation.

Information concerning installation details, power requirements, accessory connections, antennas, etc., are contained in succeeding paragraphs in this section, with appropriate references to the illustrations in Section 6.

2-B. UNITS and ACCESSORIES SUPPLIED.

1. ***narco*** MARK-12 Panel Unit.
   a. Domestic: 90 or 360 Communication Channels, as ordered.

   b. Export: 100 or 380 Communication Channels, as ordered.

2. Power Audio Unit.

   T12MP-12 for 12 volt operation, or
   T24MP-12 for 24 volt operation, as ordered.

3. Antenna connector, COMM Transceiver. ***narco*** Part No. 41130-1.

4. Antenna connector, NAV. Receiver. ***narco*** Part No. 41237-1, Plug; with 41237-2 Ferrule.

5. Mounting base-plate, for T12MP-12 or T24MP-12, ***narco*** Part No. 52085-101.

2-C. ACCESSORIES REQUIRED, but Not Supplied.

1. Cable, Modulator-Power and Accessory.
   a. 8 feet long, ***narco*** Part No. 90618-96.
   b. 16 feet long, ***narco*** Part No. 90618-192.
2. COMMUNICATIONS ANTENNA: ***narco*** VP-10, VTP-17, or equivalent.
3. NAVIGATION ANTENNA: ***narco*** VRP-15A, VRP-37, or equivalent.
4. COMMUNICATION ANTENNA CABLE, see Section J,1., below.
5. NAVIGATION Antenna Cable, see Section J,2. below.
6. Glide Slope Switching Cable, (If a Glide Slope receiver is to be controlled by the switching provided in the Mark 12 Equipment), see 2-D,2., below.
7. Headphones: Low impedance type, 300 to 1000 ohms, or Loud Speaker, Voice coil impedance, 3 to 6 ohms nominal. Both headphones and speaker may be used if desired.
8. Microphone: Low impedance carbon type. The quality of transmission depends to a considerable extent on the quality of the microphone used. A noise cancelling type is very helpful and is recommended.

2-D. OPTIONAL UNITS and ACCESSORIES AVAILABLE.

2-D,1. Cables and Connectors.

a. Glide Slope Switching Cable and Connector Kit. ***narco*** Part No. EL-2053.

b. Connector Kit, for Modulator-Power and Accessory Cable, ***narco*** Part No. EL-2052.

2-D,2. Omni Converters.

a. ***narco*** VOA-4. Omni Converter. For VOR or LOCALIZER Course Deviation.

b. ***narco*** VOA-5. Omni Converter, with Glide Slope Indicator. For VOR, LOCALIZER and Glide Slope Deviation.

c. ***narco*** VOA-6. Omni Converter. For VOR Course Deviation.

2-D,3. Quartz Crystals.

a. Crystal Kit, for conversion of Mark-12 Transceiver from 90 to 360 Communication Channels. ***narco*** Part No. EL-2051.

2-E. MECHANICAL INSTALLATION.

2-E,1. Panel Unit.

In mounting the ***narco*** Mark 12 Panel Unit the case is installed first, using mounting brackets on the sides and a grounding and supporting strap attached to the rear of the case. These supports must be fabricated by the installer. See Figure 9, page 34.

a. Rear-Mounted Case (recommended).

Install the grounding and supporting strap from the rear stud of the case to a structural member of the airframe. Allow sufficient space behind the case for cables and access to the "Airloc" fastener. Remove all paint and other finishes from the airframe, to make a good electrical ground where the supporting strap is attached.

b. Front Panel Mounting.

Where there is an existing cutout or where space limitations will not permit rear case-mounting, the case may be mounted from the front of the Instrument Panel. However, the cutout required to provide clearance for the mounting bracket bosses on the case will not be completely covered by the Mark 12 Trim Panel when the unit is inserted in the case.

Install a grounding and supporting strap from the rear stud of the case to a structural member of the airframe. Allow sufficient space behind the case for cables and access to the connectors.

c. Side Ground and Support Straps.

Provision has also been made for fastening ground and support straps on either side of the case near the rear. This may be found convenient in some installations, especially where other equipments are involved. For details see Figure 9, page 34.

2-E,2. Modulator-Power Unit.

A Mounting Base is provided to be permanently installed in the aircraft. The Modulator-Power unit is attached to this base in a manner which permits easy removal and inspection or servicing. See Figure 10, page 34 for details.

The Mounting Base and in turn the Modulator-Power Unit must have a good electrical ground, similar to the Panel Unit. See 2-E,1, above.

2-F. ELECTRICAL CONNECTIONS.

The ***narco*** Mark 12 Equipment consists primarily of a Panel Unit which becomes the central point for the electrical connections to the Modulator-Power Unit and to all other accessories. All connections are associated with the rear of the Panel Unit chassis. The rear of the chassis is readily accessible because the rear of the outside case is open, except for a narrow vertical strap which holds the ground-support stud and "Airloc" fastener.

All connections except the two separate antennas (Communication and Navigation) are made via two connectors attached to a short cable having two branches, extending from the rear of the Panel Unit chassis.

2-F,1. Modulator-Power and Accessory Cable.

The Panel Unit Cable branch having the large 16-circuit connector P-101 is to be connected to J-501, on the Modulator-Power (MP) Unit. Figure 5, page 31 gives the circuits between the mating connectors P-102 and P-501, corresponding with the Panel Unit Connector P-101 and the MP Unit Connector J-501 respectively.

The Cable Assemblies made by ***narco*** (See above 2-B,3., 2-D,2,a.) have in addition to the connections to the MP connector P-501, a five wire six foot cable for the usual microphone, headphone and loudspeaker connections. Also extending from the opening in the P-102 Cable Connector Shell are three wires about 16 inches long for the following purposes:

a. RED #16 for the Primary + DC input of either a nominal 12 or 24 volts.

b. WHITE #22 for connection of the Front Panel Lamps to an external dimmer circuit.

c. BLUE and WHITE #22 for the connection of the audio output from other equipment to the Audio Amplifier input of the Mark 12 Equipment.

NOTE: Any audio output from other equipment tied to this wire must include an appropriate series coupling capacitor, because none is incorporated in the unit.

2-F,2. Navigation Cable.

The Panel Unit Cable branch having the small 6 circuit connector P-301 is provided for connection via a mating connector to an Omni Converter Unit such as the ***narco*** VOA-4, VOA-5, or VOA-6. Connections for such units are given in the Table below and in the information supplied with the various Omni Converter Units.

If a ***narco*** VOA-6 Omni Converter is mounted near enough to a MK-12 Equipment, it may be possible to connect the P-301 connector on the MK-12 cable directly to the compatible mating connector on the VOA-6 Equipment.

For Connections, see Table V, page 30.

2-F,3. Glide Slope Channel Selector Cable.

The Navigation Receiver Channel Selector is provided with switch sections for simultaneous and automatic Glide Slope Receiver Channel Selection.

In order to use this switching when a Glide Slope Receiver such as the ***narco*** UGR-1A is provided, it is necessary to make connections directly to certain switch sections in the Mark 12 Navigation Receiver Channel Selector Assembly. A hole has been provided in the rear of the Panel Unit chassis near the bottom on the Navigation Receiver side to accommodate the necessary cable. Information on the location of the switch sections and the required connections is given in the instructions accompanying the Glide Slope Channel Selector Cable and Connector Kit. (See 2-D,2,b., above).

2-G. PRIMARY POWER.

2-G,1. Power Source.

The primary power source may be either a nominal 12 or 24 volts, depending on the connections in the Panel Unit and whether a T12MP-12 or T24MP-12 Modulator Power Unit is used.

2-G,2. Circuit and Equipment Protection.

The primary DC circuit to the equipment should be protected with a fuse or other protective device rated as follows:

15.0 amps for a nominal 12 volt installation.

7.5 amps for a nominal 24 volt installation.

2-G,3. Voltage Conversion.

a. The Modulator Power Units are made for either a nominal 12 or 24 volt operation and are not convertible from one voltage to the other.

b. The Panel Unit is made so that it can be operated as a nominal 12 or 24 volt installation, depending on a few simple connection changes on a terminal strip near the top front of the chassis and a change in the connections to the Panel Lamps.

2-G,4. Panel Unit Voltage Conversion.

a. Nominal 12 to 24 Volt Conversion.

1. Looking at the front of the chassis from above, observe the 8 terminal strip parallel with the Front Panel, located just below the volume controls. Consider the terminals numbered 8, 7, 6, 5, 4, 3, 2, 1, reading from *left* to *right*.
2. Remove two wire jumpers, one from between terminals 7 and 6, and the other from between terminals 5 and 4.
3. Connect a single wire jumper between the terminals 6 and 5.
4. Again, looking at the front of the chassis from above, observe that the right hand Panel Lamp Socket has one terminal grounded on its mounting bracket. The other terminal is connected to the left hand Panel Lamp Socket by one wire and to a source of primary DC Power by a second wire.
5. Remove the ground connection from the right hand Panel Lamp.
6. Move the wire coming from the primary DC source to the terminal which had been grounded.

The two 12-volt Panel Lamps are now connected in series across the 24 volt DC supply.

b. Nominal 24 Volt to 12 Volt Conversion.

The procedure is essentially the reverse of a. above. For convenience, it is listed here in steps.

1. Looking at the front of the chassis from above, observe the 8 terminal strip parallel with the Front Panel, located just below the volume controls. Consider the terminals numbered 8, 7, 6, 5, 4, 3, 2, 1, reading from *left* to *right*.
2. Remove the single jumper wire between the terminals 6 and 5.
3. Connect two wire jumpers, one between terminals 7 and 6 and the other between terminals 5 and 4.
4. Again, looking at the front of the chassis from above, observe that the right hand Panel Lamp Socket has one terminal connected by a wire to the left hand Panel Lamp Socket and the other terminal connected to a source of primary DC power.
5. Move the wire from the DC source to the same terminal with the wire going to the left hand Panel Lamp Socket.
6. Connect the now empty right hand Panel Lamp Socket terminal to ground by means of a short wire jumper to the Lamp Socket Mounting Bracket.

The two 12 volt Panel Lamps are now connected in parallel across the 12 volt DC supply.

2-H. ANTENNA REQUIREMENTS.

2-H,1. Communications.

Satisfactory reception and transmission calls for the use of an antenna having a nominal impedance of 50 ohms and a low Voltage Standing Wave Ratio (VSWR) over the frequency range to be used.

The 360 channel version of the ***narco*** Mark 12 Transceiver has an operating frequency range of 118 to 136 megacycles. The ***narco*** VP-10 Communication Antenna has been designed for this frequency range and is recommended for this service.

If the 90 channel version of the ***narco*** Mark 12 Equipment is to be used, the frequency range is 118 to 127 megacycles and the ***narco*** VTP-17 rod antenna may be used. This antenna will also function with the 360 channel equipment but the performance may be somewhat impaired at certain frequencies.

Also, if a 90 channel equipment is to be installed initially, with the objective of conversion to 360 channels at a later date, it may be advisable to install a ***narco*** VP-10 antenna initially.

Only one antenna is necessary for communications, since the antenna changeover switching is built into the unit.

The ***narco*** VP-10 Communication Antenna or the ***narco*** VTP-17 bent whip antenna should be mounted on as large and flat a metallic surface as is possible. Such a mounting surface is often found directly in front of the windshield in fabric covered ships or at the center of the cabin roof in metal ships. Where no such surface exists a suitable ground plane may be provided by cementing metallic foil on the inside surface of the non-metallic structure.

Do not lengthen or shorten the VTP-17 rod antenna, as it has been cut to proper length for most efficient radiation at the frequencies used.

The antenna should be located at least 12″ from other objects on the surface of the aircraft.

2-H,2. Navigation.

In any VHF radio installation, the type of antenna and its location is extremely important. Only with the proper antenna in the best location can the full range and accuracy of the VHF Omni Range system be realized. In installations where an Omni converter is to be used with the ***narco*** Mark 12 navigation receiver, **a horizontally polarized antenna is absolutely necessary.**

The quarter-wave whip, normally used for communications, is definitely not satisfactory, although it may appear to be when tried. While vertically polarized components of the omni signal are not normally radiated by the ground station, they are frequently produced by reflections. Therefore, a vertical antenna may receive strong signals not coming directly from the ground, giving very unreliable bearing information.

Location of the antenna is of primary importance. The antenna should be located well away from the engine(s) and propeller(s). Good reception is usually afforded by placing the antenna on top of the aircraft behind the cockpit or at the top of the vertical stabilizer. Other antennas and wires, located within two feet of the omni antenna may cause weak reception from some directions and should be avoided.

If the Navigation Receiver in the ***narco*** Mark 12 Equipment is to be used for communication only, it may be connected to any communication type antenna which is not being used for transmission.

Either the ***narco*** VRP-15A *mast-type* or the ***narco*** VRP-37 fin-mounting Navigation Antenna may be used with the ***narco*** Mark 12 Navigation Receiver and an Omni Converter.

The RF cable should be RG-58A/U of as short a length as is practical. All bends should have at least a 6″ radius.

If another navigation receiver is to be operated from the same antenna as the MARK 12, the following precautions should be taken. The electrical length of the RF Cable from the MARK 12 Unit to the interconnecting "T" should be 22⅝″ long, plus any multiples of 35″ necessary for installation. To determine the length of the cable necessary for any other Narco Equipment connecting to this "T", consult the appropriate instruction book.

2-J. POST-INSTALLATION CHECK-OUT.

After the installation has been completed, it should be operated on the ground, with all normal power turned on and the engine(s) running. The receivers should be checked for proper operation by channeling to available signals. A ground check of the transmitter should be made to determine output and audio quality. This may be done contacting the Control Tower.

CAUTION

When making tests on the COMM Receiver with a Signal Generator connected to the COMM. Antenna Connector, do not close the microphone switch or activate the transmitter in any way. This is to protect the Signal Generator from transmitter output power.

SECTION 3
OPERATION

3-A. INTRODUCTION.

The information concerning the operation of the ***narco*** Mark 12 Equipment contained in this manual is primarily functional, for the purpose of providing proper maintenance.

Complete control of the operation of the ***narco*** Mark-12 Equipment is confined to a few direct manual controls on the front of the Panel Unit.

3-A,1. Panel Unit Controls.

The controls consist of two Channel Selectors, two volume controls and an ON-OFF Primary DC Power Switch on the COM volume control. All references in the paragraphs below are as viewed looking at the front panel.

a. Communication Transceiver.

The Communication (COM) Transmitter and Receiver are combined in the left side of the Panel Unit Assembly and both are controlled by the left hand pair of Channel Selector Knobs.

The large outer knob operates the whole megacyle (Mc) channel selector switch sections near the left front and center of the chassis assembly. The selected whole Mc frequency appears in the upper row of numerals on the Selector.

The central COM knob operates the fractional megacycle (Mc) switch sections near the left rear of the chassis assembly. The selected fractional Mc frequency appears in the lower row of numerals on the selector.

The small knob near the top, to the left of the center operates the COM Receiver Volume Control and near its maximum counter-clockwise position operates the primary DC Power ON-OFF Switch for both the Transceiver and the Navigation Receiver.

b. Navigation Receiver.

The Navigation (NAV) Receiver Channel Selector on the right hand side operates the channel selector switches and indicates the selected channel in the same manner as the COM Selector described under **a.,** above.

In addition to selecting the NAV Receiver Channel the NAV Channel Selector is provided with switch sections for automatically selecting the corresponding GLIDE SLOPE CHANNEL, when a Glide Slope Receiver such as the ***narco*** UGR-1A Equipment is installed.

The NAV Receiver volume is controlled by the small knob near the top, to the right of the center.

3-A,2. Operating Procedures.

Information concerning operation procedures is provided in the Operators Manual which is shipped with each Equipment.

Also, much information on operating practice is provided in the current issues of the FAA Flight Information Manual, the FAA Airmans Guide, the various Local, Sectional and WAC Charts, Radio Facility Charts, etc.

SECTION 4
CIRCUIT DESCRIPTION

4-A. INTRODUCTION.

The ***narco*** Mark 12 Equipment is contained in a Panel Unit intended for aircraft instrument panel mounting and a Modulator-Power Unit which may be mounted in a remote location. The two units are interconnected by a cable which may be as much as 16 feet long.

4-A,1. Panel Unit.

The Panel Unit contains two major items, a Communications Transceiver and a Navigation Receiver. The Transceiver consists of a VHF Transmitter and Receiver, operated by a single control, to provide "simplex" communication on either 90 or 360 crystal controlled channels. The Navigation Receiver has 100 channels for OMNI Navigation and ILS Localizer service. Separate connectors are provided for Communication and Navigation Antennas.

The Panel Unit may be operated on a nominal DC Supply Voltage of either 12 or 24 volts, depending on a few simple connection changes on a terminal strip.

4-A,2. Modulator-Power Unit.

The Modulator-Power Unit contains an Audio Amplifier/Modulator and a DC to DC Converter. The Audio Amplifier serves as the transmitter modulator in the transmit condition and operates the headphones and loudspeaker in the receive condition. The DC to DC Converter changes the primary DC supply to the DC voltages required by the various circuits.

The Modulator-Power Units are not convertible from one primary DC voltage to another. There are two types available. The Type T12MP-12 is to be used on a nominal 12 volt DC supply and the Type T24MP-12 is to be used on a nominal 24 volt DC supply.

4-B. COMMUNICATIONS TRANSMITTER.

There is a maximum of 360 (380 in the export version) crystal controlled transmitter channels provided by the Mark-12, using the difference frequency between the second harmonic of the high frequency oscillator, V-205, and the fundamental frequency of the low frequency oscillator, V-103B.

The high frequency oscillator (HFO), V-205, is a crystal stabilized, modified Colpitts oscillator employing a 7587 nuvistor vacuum tube. It uses fifth overtone crystals and operates on the fundamental oscillator frequencies 63.7375 Mc to 72.2375 Mc (63.2375 Mc to 72.2375 Mc in the export version) in 0.5 megacycle steps.

The low frequency oscillator (LFO), V-103B, is an untuned, crystal controlled Colpitts oscillator employing the triode section of a 6EA8 vacuum tube. It operates in the frequency range of 8.525 Mc to 9.475 Mc in 50 or 100 kilocycle steps.

Second harmonic HFO energy is applied to the control grid of V-204, which is a balanced mixer used to supress second harmonic energy of the HFO in the transmitter output circuits.

Fundamental energy of the LFO is applied to one of the deflection plates of V-204 through C-266. The difference frequency, selected by the plate circuit of V-204, is applied to the control grid of the first amplifier, V-203. The tube, V-203, amplifies this signal and applies it to the control grid of the second amplifier, V-202, where it is further amplified and applied to the final amplifier, V-201.

The final amplifier is a 7551 beam power amplifier. It delivers approximately 8 watts of RF carrier power through a "T" filter to the antenna. CR-101 is used as a T-R relay and is biased so that it blocks energy into the receiver tuned circuit during transmit time.

High level plate modulation is applied to the final amplifier by the T( )MP-12 transistorized modulator-power unit.

4-C. COMMUNICATIONS RECEIVER.

A crystal controlled, double conversion superhetrodyne circuit is employed in the communications receiver of the Mark-12. The desired RF signal enters the receiver at the communications transceiver antenna connector, J-101. The signal is applied through CR-101, which has its bias controlled so that it serves as a T-R relay, to the first of three RF tuned circuits. These circuits are tuned in steps of one megacycle by the use of gang tuned variable inductors. The RF signal is amplified by V-101(6BH6) and applied through a capacitively coupled double tuned circuit to the control grid of the first mixer, V-102.

The high frequency oscillator (HFO), V-205, is a crystal stabilized, modified Colpitts oscillator. Its fundamental frequency range, using fifth overtone crystals, is 63.7375 Mc to 72.2375 Mc (63.2375 Mc to 72.2375 Mc in export version) in 0.5 Mc steps. The plate circuit is tuned to the second harmonic of the oscillator, and second harmonic energy is injected through C-233 and C-113 to the control grid of the first mixer V-102.

The high frequency IF (first IF) is produced by selecting the difference frequency between the incoming RF signal and the HFO injection energy. This difference frequency selection is accomplished by a tuned circuit containing T-101 and T-102. The tuning of T-101 and T102 is done in 50 kilocycle steps by gang switched step inductors. The HF IF is tuned over the range of 8.525 Mc to 9.475 Mc. The output of the HF IF is applied to the control grid of the second mixer V-103A.

The low frequency oscillator (LFO), V-106, is an untuned crystal controlled Colpitts oscillator operating in the frequency range of 8.525 Mc to 9.475 Mc in 50 or 100 kilocycle steps. The output of this oscillator is injected to the screen grid of the second mixer, V-103, through C-123.

The low frequency IF (second IF) is produced by selecting the difference frequency between the high frequency IF output and the LFO injection energy. This selection is done by T-103, which is the first of three 0.5 Mc IF transformers. T-103, T-104, and T-105 are overcoupled to give an adequate bandwidth. The signal from T-103 is applied to the control grid of V-104. It is amplified by V-104, applied through T-104 to V-105 where it is again amplified. It is then applied through T-105 to CR-102, which is a silicon diode detector. The output of the peak limiting noise limiter, CR-103, is the input to the audio volume control, R-122. The output of the audio volume control is applied through R-319 and C-348 to the control grid of the cathode follower V-305B.

AVC is developed by detector current flow across R-118, R-121 and R-123. AVC is applied to the RF and IF stages with the exception of the last IF amplifier V-105.

4-D. NAVIGATION RECEIVER.

A double conversion superhetrodyne circuit is employed in the navigation receiver of the Mark-12. The desired signal enters the receiver at the navigation receiver antenna connector, J-301. The signal is applied to the first of three tuned RF circuits. These circuits are tuned in steps of one megacycle by the use of gang tuned variable inductors. The RF signal is amplified by V-301 (6BH6) and applied through a capacitively coupled, double tuned circuit to the control grid of the first mixer, V-302.

The high frequency oscillator (HFO), V-305A, is a crystal stabilized grounded grid oscillator. Its frequency range, using fifth overtone crystals, is 96.55 Mc to 104.55 Mc in one megacycle steps. Fundamental oscillator energy is injected through C-310 to the control grid of the second mixer, V-302.

The high frequency IF (first IF) is produced by selecting the difference frequency between the incoming RF signal and the HFO injection energy. This difference frequency selection is accomplished by a tuned circuit containing T-301. The tuning of T-301 is done in 100 kilocycle steps by gang switched step inductors. The HF IF is tuned over the range of 11.45 Mc to 12.35 Mc. The output of the HF IF is applied to the control grid of the second mixer, V-303.

The low frequency oscillator (LFO) is a Colpitts oscillator operating in the range from 10.025 Mc to 10.925 Mc. It is inductively tuned, by the step inductor L-315, in 100 kilocycle steps. The output of this oscillator is injected to the control grid of the second mixer, V-303, through C-316 and the secondary circuit of T-301.

The low frequency IF (second IF) is produced by selecting the difference frequency between the output of the HF IF and the LFO injection energy. This selection is done by T-302, which is the first of two 1.425 Mc IF transformers. T-302 and T-303 are overcoupled to give an adequate bandwidth. The signal from T-302 is applied to the control grid of V-304. It is amplified by V-304 and passed through T-303 to CR-301, which is a silicon diode detector.

The omni output is applied from the diode load directly to the omni converter input. The peak limiting noise limiter, CR-303, is a silicon diode. The output of the noise limiter is the input to the audio volume control, R-318. The output of the audio volume control is applied through R-320 and C-347 to the control grid of the cathode follower V-305B.

The delayed AVC is developed by detector current flow through R-317, R-333, and R-316 and is applied to the RF and IF stages with the exception of the last IF stage, V-304. The time constant of the AVC is very slow to provide accurate omni range bearings.

4-E. MODULATOR-POWER UNIT.

The power supply section of the T( )MP12 uses two power transistors, Q-501 and Q-502, and a power transformer, T-501, in a circuit whose simplified operation is as follows. The instant primary voltage is applied (A+), because of the inevitable dissimilarity of the two transistors, more current will flow in one than in the other. This greater flow of current through one half of the primary winding of the power transformer induces a bias on the transistors such that the conducting unit is driven into greater conduction and the other is held at cut-off.

Almost instantly the transformer reaches saturation. Thus having reached maximum flux density, there is no more induced voltage in the bias windings which are connected to the transistor circuitry. Therefore, the current through the conducting transistor decreases, and bias voltage at opposite polarity is developed which cuts off this transistor and simultaneously causes the second transistor to conduct. The above procedure repeats with the second transistor. This switching action repeats at high speed and the resultant output voltage of T-501 is essentially a square wave.

A full wave bridge rectifier consisting of CR-501, CR-502, CR-503, and CR-504 in conjunction with the center tapped secondary of T-501 provides a simple means of obtaining a dual voltage output. Filtering of these DC voltages is easily accomplished because of the high frequency of the power supply.

The audio section of the T( )MP12 is also transistorized. It contains Q-401, Q-402, Q-403, T-401, T-402 and their associated components. This section serves two functions. In transmit, Q-401 performs the function of microphone amplifier. It drives Q-402 and Q-403, through T-401, to perform the function of transmitter modulator. Modulation is accomplished by transformer action in T-402 since final current flows through one secondary winding of T-402.

In receive operation, Q-401 performs the function of an audio amplifier and is driven by the cathode follower V-305B. The output of Q-401 is transformer coupled, through T-401, to Q-402 and Q-403, which perform the function of audio output amplifiers. The output of the audio amplifiers is transformer coupled, by T-402, to a speaker, and/or capacity coupled through C-404 to headphones.

SECTION 5
MAINTENANCE

5-A. INTRODUCTION.

The ***narco*** Mark 12 Equipment consists primarily of an aircraft instrument Panel Unit, having direct manual controls and a remote mounted modulator-power unit. All interconnections are normally made at or near the rear of the Panel Unit. There are separate single circuit connectors for the Communication and Navigation Antennas on the rear panel.

There are two kinds of Panel Unit chassis in service. They are type CN-89 and CNP-89. They differ mostly in the way in which connections, other than antennas, are made at the rear of the panel unit. There is also some difference in the gain or signal level in the Communication receiver.

5-A,1. Panel Unit Chassis Type CN89 Connections.

The Type CN89 Panel Unit Chassis has a short cable with two branches extending from the rear. The smaller branch has a 6 circuit connector which may connect directly or via an extension cable to a ***narco*** VOA-6 OMNI Converter, or via an adaptor cable to a ***narco*** VOA-4, VOA-5, or other Navigation Converter. The larger branch has a 16 circuit connector to accommodate the connector and cable for the Modulator-Power Unit and the connections to the primary DC Power and accessories.

If a Glide Slope Receiver such as the ***narco*** UGR-1A is being controlled by the channel selector of the Navigation receiver, there will be an additional cable extending from the rear of the Panel Unit.

For details of these interconnections see Figures 7 and 8, pages 32 and 33.

5-A,2. Panel Unit Chassis Type CNP89 Connections.

The Type CNP89 Panel Unit Chassis has all connectors mounted directly on the rear of the chassis, instead of being attached to short cables extending from the chassis.

The 16 circuit connector on the chassis provides the same circuits and functions as the 16 circuit connector on the CN89 cable. Connections to the Modulator-Power Unit, +DC Supply, Accessories, etc., are all the same. See Figures 4 and 5, page 31.

5-B. MECHANICAL MAINTENANCE.

5-B,1. Panel Unit Access.

The Panel Unit Case is normally installed permanently in the aircraft. To remove the unit, it is only necessary to disconnect the cables at the rear of the chassis and release a single "Airloc" fastener. The unit may then be withdrawn from the front of the case.

The open frame chassis design is such that practically every component, except the ones in the three small shielding compartments, is readily accessible as soon as the unit is withdrawn from the case. Disassembly and re-assembly of the COM and NAV Channel Selectors is somewhat involved, but detailed instructions for the procedure are given in paragraphs 5-B,4 through 5-B,12 below.

The components in the three small shielding compartments are made accessible by removing the covers, which are held in place by small screws. The two compartments near the center of the chassis have both top and bottom covers.

A certain sequence of replacing the covers of the center compartments is helpful. The bottom cover on the left center (COMM side) may be removed and replaced without disturbing top cover. However, if the top cover is removed, it will be easier to remove the bottom cover before reassembly of the top cover. Once the top cover is in place, the bottom cover may be re-assembled without difficulty.

NOTE: The bottom cover fits *inside* the top cover.

The top cover on the right center compartment (NAV. Side) may be removed and replaced without disturbing the bottom cover. However, if the bottom cover is removed, it will be easier to first remove the top cover before reassembly of the bottom cover.

The remaining compartment at the bottom left front (COM side) has only one cover. It is held in place by one screw at the rear flange of the cover and two tabs on the front flange of the cover. The tabs fit into slots at the front of the compartment proper.

5-B,2. Modulator-Power Unit Access.

The Modulator Power Unit is usually installed in a remote location on a Mounting Base. The Mounting Base is normally installed permanently. To remove the Unit, it is only necessary to loosen (without removing) four mounting screws and detach the single cable connector. Access to all components is then made by removing the screws holding the two "L" shaped pieces covering the four sides.

If the Transistor Q-401 (First Audio Amp.) is removed, care must be exercised to prevent damaging the insulator under the mounting, and to replace it properly.

5-B,3. Periodic Service.

The only item which may require occasional attention is the COM Fractional Mc Channel Selector Detent Assembly, near the rear of the chassis. It consists of a star wheel, roller, and detent fulcrum, which should be lubricated with wide temperature range grease. It is recommended that this assembly be checked whenever the Unit is removed for electrical maintenance.

5-B,4. Channel Selector Knob, Dial and Shaft Removal, Replacement and Positioning.

The procedures for disassembly and re-assembly of the Channel selectors given in the succeeding paragraphs 5-B,5., through 5-B,9., give a procedure which should maintain the proper relations among the Knobs, Dials, Shafts, and Switch Section Rotors and Stators. If these relations become mis-arranged for any reason the correct relations may be re-established according to the sub-section 5-B,10., below.

NOTE: In the succeeding sub-sections through 5-B,12., all references to mechanical position such as top and bottom, left and right, front and rear are as viewed facing the front of the Panel Unit in an upright position.

5-B,5. COM Fractional Mc Shaft, Removal and Replacement.

Removal Procedure:

a. Remove detent spring and roller which engages the star wheel assembly at the left side rear of the set on the COM. Fractional Mc Shaft and then loosen the two set screws in the star wheel assembly.

b. Rotate the COM. Mc Knob to the 118 position, the COM. Fractional Mc Dial to the 0.3 position, and the NAV. Mc Knob to the 108 position and the NAV. Fractional Mc Dial to the 0.6 position.

CAUTION: If the knobs and dials are not set as indicated, the switch sections may be damaged, when the shafts are removed as described under step g. below.

c. Loosen set screws and remove from the Unit both Volume Knobs, COM. Fractional Mc Knob and the NAV. Fractional Mc Knob.

d. Loosen set screws in the following parts. COM. Mc Knob, NAV. Mc Knob, COM. Fractional Mc Dial, and NAV. Fractional Mc Dial.

e. Loosen and remove the four screws at the corners of the Trim Panel. The Panel can now be removed by pulling it forward from the Unit. Note COM. Mc Knob, COM. Fractional Mc Dial, NAV. Mc Knob and NAV. Fractional Mc Dial will come off with removal of Trim Panel as they are captivated in this assembly.

f. Front of chassis is now exposed. On the left hand side is the COM. Mc detent. Remove its screws, nuts, lockwashers, and the spacers which retain the detent assembly to the front of the chassis.

g. Note that it is necessary to remove the COM. Mc Shaft in order to remove the COM. Fractional Mc Shaft. Both COM. Mc Shaft and detent assembly and COM. Fractional Mc Shaft can now be withdrawn simultaneously from the front of the chassis.

Replacement Procedure: Follow the Removal Procedure in reverse.

5-B,6. COM Whole Mc Shaft and Detent Assembly, Removal and Replacement.

Removal Procedure:

Follow instructions described in Removal Procedure 5-B,5., above but omit step a. and step g. The COM Mc Shaft and Detent Assembly can now be withdrawn from the front of the chassis without disturbing the COM Fractional Mc Shaft and Detent.

Replacement Procedure:

Follow the Removal Procedure in reverse.

5-B,7. NAV Whole Mc Shaft and Detent Assembly, Removal and Replacement.

Removal Procedure:

a. See Removal Procedure 5-B,5., above and perform steps b., c., d., and e.

b. After the above steps have been completed, the front of the chassis will be exposed and on the right hand side will be the NAV Mc Shaft and Detent Assembly. This can then be removed by loosening and removing the two mounting nuts and lockwashers at the rear of the variable inductor and crystal switch section assembly.

c. In the same area remove the hairpin retainer from the NAV Mc Shaft.

d. On the front of the chassis the two long strut screws can now be removed, but be careful to note the location of the two metal spacers in the wafer assembly.

e. The NAV Mc Detent and Shaft Assembly can now be withdrawn from the front of the chassis.

Replacement Procedure:

Follow the Removal Procedure in reverse.

5-B,8. NAV. Fractional Mc Shaft, Removal and Replacement CN-89 Chassis Only.

Removal Procedure:

a. Position the NAV Fractional Mc Dial to 0.6. Then loosen the set screw which is seated the deepest in the NAV Fractional Mc Knob and remove the knob and its bushing from the Unit.

b. Loosen the two set screws in the hub of the NAV. Fractional Mc Dial.

c. At the rear of the L.F. Oscillator, glide slope, and variable inductor switch sections, there is a detent rotor assembly. Loosen the two set screws in the detent rotor assembly and also remove the hairpin retainer on the NAV Mc Shaft in front of the L.F. Oscillator Assembly.

d. Then from the front of the chassis, push in the NAV Fractional Mc Shaft flush with the front of the NAV Whole Mc Shaft. It will be seen by this operation that the NAV Fractional Mc Shaft will be protruding to the rear of the set, at the rear of the LF oscillator and switch section assembly. Continue to withdraw the shaft to the rear of the set.

e. In the rear panel there is a clearance hole provided to facilitate the removal of this shaft. Any wires interfering with this clearance hole should temporarily be carefully dressed aside.

Replacement Procedure:

Follow the Removal Procedure in reverse.

5-B,9. NAV. Fractional Mc Shaft Removal and Replacement. CNP-89 Chassis Only.

Removal Procedure:

Follow instructions described in Removal Procedure 5-B,8 above. In addition it will be necessary to remove the two screws on the rear panel of the chassis which support the plug and connector bracket. The clearance hole in this bracket should be held in line with the clearance hole in the rear panel to facilitate removal of the shaft.

Replacement Procedure:

Follow Removal Procedure in reverse.

5-B,10. Reference Positions for Channel Selector Dials, Shafts, and Switch Sections.

a. COM Fractional Megacycles.

For the 0.5 Fractional Mc position the ⅜" diameter metal shaft flats will be in a horizontal plane, with the key notch in the Switch Section Rotors at the top.

All of the Switch Section Stators have the letters "X" stamped on the front right side adjacent to the strut screw.

b. COM Whole Megacycles.

For the 118 Whole Mc position the ⅜" diameter glass epoxy shaft flats will be 18° clockwise from a vertical plane, with all the key notches in the Switch Section Rotors on the right side at 108° clockwise from the vertical.

The first seven Switch Section Stators have the upper right hand corner cut off. The remaining four, have the letter "X" stamped on the top front of the section.

c. NAV Whole Megacycles.

For the 108 Whole Mc position the flats on the ¼" diameter *brass* shaft shall be in the same plane as the mounting strut screws in the Crystal Switch Assembly. The key notch in the eight Switch Section Rotors is on the flat toward the bottom of the Unit.

The eight Switch Section Stators have a raised key moulded on the peripheral surface, which appears at the right of the top strut screw.

d. NAV Fractional Megacycles.

For the 0.6 Fractional Mc dial position the flats on the ¼" diameter *steel* shaft shall be in the same plane as the mounting strut screws in the L.F. Oscillator Assembly. The key notch of the rotor in the enclosed shielded switch section (top cover removed) is on the flat toward the top of the Unit. The key notch in the five switch section rotors behind the enclosed shielded switch section, is on the flat toward the bottom of the Unit.

The Switch Section Stator in the shielding compartment has a large cutout at the top. The remaining five stators have a raised key moulded on the peripheral surface, which appears at the right side below the upper strut screw.

5-B,11. COM Detent Spring Position, Fractional Mc, Ch. Sel. Switch.

When the detent star wheel assembly is installed for 10 position operation, the long end of the detent spring shall be located on the inside edge of the tab nearest the shaft.

When the detent star wheel assembly is installed for 20 position operation, the long end of the detent spring shall be located on the inside edge of the outermost tab from the shaft.

5-B,12. NAV Detent Position, Fractional Mc, Ch. Sel. Switch.

This detent position is not related to any particular fractional Mc position, but it must be seated when the rotor blade is centered on any stator contact. This centering may be observed on the switch section in the enclosed shielded compartment, when the top cover is removed.

5-C. ELECTRICAL MAINTENANCE.

5-C,1. Precautions.

a. Supply Voltage.

NOTE: In order that the conditions in the following alignment procedure may be met, the DC input voltage to the unit must be 13.75 VDC or 27.5 VDC, depending on input requirement of unit under test, when the transmitter is keyed.

b. Duty Cycle.

It must also be emphasized that a 20% duty cycle should be observed when aligning the transmitter—one minute on and four minutes off.

5-C,2. Equipment Required.

a. RF Power Wattmeter — Bird Termaline or equivalent.

b. VTVM —RCA Voltohmyst or equivalent.

c. AC VTVM — Ballentine Model 300D or equivalent.

d. Carbon Microphone.

e. Signal Generator — General Radio Model 1001A or equivalent.

f. Signal Generator — Hewlett Packard Model 608D or equivalent.

g. Audio Wattmeter — General Radio Type 583-A or equivalent.

h. High Impedance Dummy Detector — See Figure 1., page 30.

i. Frequency Counter—Hewlett Packard Model 524B or equivalent.

j. Frequency Meter — BC-221-D or equivalent.

k. RF Voltmeter — Hewlett Packard Model 410B or equivalent.

5-D. TRANSMITTER ALIGNMENT.

Reference: Schematic, Fig. 11, page 55.

5-D,1. Low Frequency Oscillator.

Procedure:

a. Connect a 50 ohm RF Power Wattmeter to J-101.

b. Connect a VTVM, through a one megohm resistor, to Pin 9, V-103B. Set the VTVM to indicate negative DC, 15 volt scale.

c. Key the transmitter and observe the VTVM indication for each of the fractional Mc selector positions. An indication of approximately –6 VDC should be observed.

d. Un-key the transmitter and remove the RF wattmeter from J-101. Remove the one megohm resistor and the VTVM from Pin 9, V-103B.

Normal Indication:

Approximately –6.0 VDC, measured through a one megohm resistor, on Pin 9, V-103B on all fractional Mc selector positions.

5-D,2. High Frequency Oscillator.

Procedure:

a. Connect a 50 ohm RF power wattmeter to J-101.

b. Connect a VTVM, through a one megohm resistor, to Pin 4, V-205. Set the VTVM to indicate positive DC, 15 volt scale. Key the transmitter.

c. Set the Mc selector to the 118 position. Adjust C-241 for minimum positive DC indicated on the VTVM.

d. Set the Mc selector to the 135 position (126 on the 90 channel version) and adjust L-218 for minimum positive DC indicated on the VTVM.

e. Repeat steps c. and d. until no further decrease in positive DC indication can be obtained.

f. Observe the VTVM indication for each of the Mc selector positions. The indication should be approximately +8 VDC. It is well to note that the non-oscillating potential is approximately +10 VDC.

g. Un-key the transmitter and remove the RF wattmeter from J-101. Remove the one megohm resistor and the VTVM from Pin 4, V-205.

Normal Indications:

Approximately +8.0 VDC, measured through a one megohm resistor, on Pin 4, V-205 on all Mc selector positions.

5-D,3 Doubler, High Frequency Oscillator.

Procedure:

a. Connect a 50 ohm RF power wattmeter to J-101.

b. Connect a VTVM, through a one megohm resistor, to Pin 6, V-204. Set the VTVM to indicate negative DC, 15 volt scale. Key the transmitter.

c. Set the fractional Mc selector to the 0.5 position. Set the Mc selector to the 118 position. Adjust C-237 for maximum indication on the VTVM.

d. Set the Mc selector to the 135 position (126 on the 90 channel version). Adjust L-215 for maximum indication on the VTVM.

e. Repeat steps c. and d. until no further increase in VTVM indication can be obtained. Observe the indication for each of the Mc selector positions. The indication should be approximately –3.5 VDC.

f. When the conditions described above have been achieved, the deflector drive voltage should be checked with an RF voltmeter. This voltage measured on Pin 2, V-204, should be approximately 8.5 volts RMS. A Hewlett Packard 410B is suitable for this measurement. This voltage is an indication of the RF output of the LF oscillator, which cannot be accurately measured before this time.

g. Un-key the transmitter and remove the RF wattmeter from J-101. Remove the one megohm resistor and VTVM from Pin 6, V-204.

Normal Indication:

Approximately –3.5 VDC measured on Pin 6, V-204.

5-D,4. Transmitter Amplifiers.

Procedure:

a. Connect a 50 ohm RF power wattmeter to J-101.

b. Connect a one megohm resistor to Pin 7, V-203. Connect a VTVM to the one megohm resistor. Set the VTVM to indicate negative DC, 1.5 volt scale. Key the transmitter.

c. Set the fractional Mc selector to the 0.5 position. Set the Mc selector to the 118 position. Adjust C-228 for maximum indication on the VTVM.

d. Set the Mc selector to the 135 position (126 on the 90 channel version). Adjust L-214 for maximum indication on the AC VTVM.

e. Repeat steps c. and d. until no further increase in VTVM indication can be obtained.

f. Set the VTVM to indicate negative DC, 15 volt scale. Connect it to the junction of C-219 and R-227. This measures the control grid voltage on V-202.

g. Set the Mc selector to the 118 position. Adjust C-221 for maximum indication on the VTVM.

h. Set the Mc Selector to the 135 position (126 on the 90 channel version). Adjust L-211 for maximum indication on the VTVM.

i. Repeat steps g. and h. until no further increase in VTVM indication can be obtained.

j. Set the VTVM to indicate negative DC, 150 volt scale, and connect it to the junction of C-209 and R-226. This measures the control grid voltage on the final amplifier V-201.

k. Set the Mc selector to the 118 position. Adjust C-213 for maximum indication on the VTVM.

l. Set the Mc selector to the 135 position (126 on the 90 channel version). Adjust L-207 for maximum indication on the VTVM.

m. Repeat steps k. and l. until no further increase in VTVM indication is obtained.

n. Set the Mc selector to the 118 position. Adjust C-204 for maximum power indicated on the RF wattmeter.

o. Set the Mc selector to the 135 position (126 on the 90 channel version). Adjust L-202, by changing the spacing between turns, for maximum power indicated on the RF wattmeter.

p. Repeat steps h. and o. until no further increase in RF power is obtained.

q. Set the Mc selector to the 118 position. Adjust C-237, C-228, C-221 and C-213 in that order for maximum indication on the VTVM. Adjust C-204 for maximum power indicated on the RF wattmeter.

r. Set the Mc selector to the 135 position (126 on the 90 channel version). Adjust L-215, L-214, L-211 and L-207 for maximum indication on the VTVM. Adjust L-202 for maximum power indicated on the RF wattmeter.

s. Repeat steps q. and r. until no further increase in drive voltage and RF power is obtained.

t. Un-key the transmitter. Remove the VTVM and the one megohm resistor on Pin 7, V-203 from the unit. Remove the RF wattmeter from J-101.

Normal Indications:

First Amplifier—Approximately –0.5 VDC measured, through a one megohm resistor, on Pin 7, V-203.

Second Amplifier—Approximately –8.0 VDC measured at the junction of C-219 and R-227.

Final Amplifier—Approximately –80.0 VDC measured at the junction of C-209 and R-226.

Final Output Tank—Approximately 8 watts of RF carrier power measured on a 50 ohm RF power wattmeter.

5-E. COMMUNICATIONS RECEIVER ALIGNMENT.

Reference: Schematic, Fig. 11, page 55.

5-E,1. High Frequency Oscillator.

Procedure:

The high frequency oscillator is to be tracked in transmit function. Refer to the transmitter alignment procedure for the high frequency oscillator alignment procedure.

Normal Indication:

+7 to +9 VDC from 118 Mc through 135 Mc.

5-E,2. Low Frequency Oscillator.

Procedure:

The low frequency oscillator drive is to be measured at the control grid of V-106 through a 1 megohm resistor. This oscillator is an untuned, crystal controlled Colpitts oscillator.

Normal Indication:

–3.5 to –6.0 VDC from 0.00 Mc through 0.95 Mc.

5-E,3. Low Frequency IF Amplifier.

Procedure:

a. Connect AC VTVM to the junction of CR-103 and R-122.

b. Remove all connections from Pin 2, V-103. Connect a 47 ohm resistor from Pin 2, V-103 to ground. Connect signal generator to Pin 2, V-103. Set the signal generator to 500 Kc, 400 cps 30% modulation. Increase the signal generator output for a usable indication on the AC VTVM.

c. Set the signal generator to 490 Kc and tune the primary and secondary tuning slugs of T-103, T-104, and T-105 for maximum indication on the AC VTVM.

d. Set the signal generator to 510 Kc and tune the primary and secondary tuning slugs of T-103, T-104, and T-105 for maximum indication on the AC VTVM.

e. Repeat steps c. and d. until no further increase in AC VTVM indication is obtained, and peak amplitudes are approximately equal with approximately 20 Kc peak separation. The hole depth between the two peaks should be approximately 2.5 db.

f. Figure 2, page 30, illustrates the low frequency IF response.

g. Remove the signal generator and the 47 ohm resistor from Pin 2, V-103, and reconnect the components previously removed. Remove AC VTVM from junction of CR-103 and R-122.

Normal Indication:

75 μv (380 μv for CNP-89) maximum input for 0.60 VAC noise limiter output.

5-E,4. Selectivity, LF IF Bandwidth.

Procedure:

a. Connect AC VTVM to the junction of CR-103 and R-122.

b. Remove all connections from Pin 2, V-103. Connect a 47 ohm resistor from Pin 2, V-103 to ground. Connect the signal generator to Pin 2, V-103. Set the signal generator to 500 Kc, 400 cps 30% modulation.

Adjust signal generator output level to produce a usable indication on AV VTVM.

c. Vary the signal generator frequency across LF IF response. It will be noted that the response peaks approximately 10 Kc either side of 500 Kc, with 500 Kc falling at the bottom of a "hole" or "dip" in the response between the two peaks. See Figure 2, page 30, for low frequency IF response. Use the AC VTVM indication at this "hole" in the response, at 500 Kc, as the reference level to measure bandwidth.

d. With the reference level set, increase the generator output 6 db (2:1). Tune the signal generator frequency below 500 Kc until the reference level is obtained on the AC VTVM. Note this frequency. Tune the signal generator frequency above 500 Kc until the reference level is obtained on the AC VTVM. Note this frequency. The difference between the two noted frequencies is the total 6 db bandwidth.

e. With the reference level set, increase the signal generator output 60 db (1000:1). Tune the signal generator frequency below 500 Kc until the reference level is obtained on the AC VTVM. Note this frequency. Tune the signal generator frequency above 500 Kc until the reference level is obtained on the AC VTVM. Note this frequency. The difference between the two frequencies is the total 60 db bandwidth.

f. Remove the signal generator and the 47 ohm resistor from Pin 2, V-103 and reconnect the components previously removed. Remove the AC VTVM from junction of CR-103 and R-122.

Normal Indication:

6DB—32 Kc minimum total bandwidth.
60DB—95 Kc maximum total bandwidth.

5-E,5. LFO Conversion Gain.

Procedure:

a. Connect AC VTVM to the junction of CR-103 and R-122.

b. Remove all connections from Pin 2, V-103. Connect a 47 ohm resistor from Pin 2, V-103 to ground. Connect the signal generator to Pin 2, V-103 and set it to 10 Mc range, 400 cps 30% modulation.

c. Set the fractional Mc selector to the .00 position. Tune the signal generator to 9.475 Mc. Note indication on AC VTVM. Set the fractional Mc selector to the 0.50 position. Tune the signal generator to 8.975 Mc. Note indication on AC VTVM. Set the fractional Mc selector to the 0.90 position. Tune the signal generator to 8.575 Mc. Note indication on AC VTVM.

d. Remove the signal generator and the 47 ohm resistor from Pin 2, V-103 and reconnect all components previously removed from Pin 2, V-103. Remove the AC VTVM from the junction of CR-103 and R-122.

Normal Indication:

15 Kμv (100 Kμv for CNP-89) maximum input for 0.6 VAC noise limiter output.

5-E,6. HF IF Amplifier.

Procedure:

a. Connect AC VTVM to the junction of CR-103 and R-122.

b. Remove all connections from Pin 1, V-102. Connect a 47 ohm resistor from Pin 1, V-102 to ground. Connect signal generator to Pin 1, V-102. Set signal generator to 10 Mc range. 400 cps 30% modulation.

c. Set the fractional Mc selector to the 0.00 position. Set the signal generator to 9.475 Mc. Increase the signal generator output to obtain a usable indication on the AC VTVM. Tune the primary and secondary tuning slugs of T-101 and T-102 for maximum indication on the AC VTVM.

d. Set the fractional Mc selector to the .90 position. Set the signal generator to 8.575 Mc. Tune C-117, C-118, and C-122 for maximum indication on the AC VTVM.

e. Repeat steps c. and d. until no further increase of AC VTVM indication is obtained.

f. Check all fractional Mc positions for normal indication.

g. Remove the signal generator and the 47 ohm resistor from Pin 1, V-102, and reconnect the components previously removed. Remove the AC VTVM from the junction of CR-103 and R-122.

Normal Indication:

25 μv (180 μv for CNP-89) maximum for 0.6 VAC noise limiter output.

5-E,7. RF Amplifier.

Procedure:

a. Connect AC VTVM to the junction of CR-103 and R-122.

b. Connect signal generator to J-101.

c. Set the signal generator to the 118 - 136 Mc range, 1000 cps 30% modulation.

CAUTION—Do not key the transmitter. To do so may damage the signal generator.

d. Set the fractional Mc selector to the 0.50 position. Set the Mc selector to the 118 position. Set the signal generator to 118.50 Mc and set its output for a usable indication of the AC VTVM. Adjust C-104, C-109, and C-112 for maximum indication on the AC VTVM.

e. Set the Mc selector to the 135 position (126 for the 90 channel version). Set the signal generator to 135.50 Mc (126.50 for the 90 channel version). Adjust L-102, L-104, and L-106 for maximum indication on AC VTVM.

f. Repeat steps d. and e. until no further increase in AC VTVM indication is obtained.

g. Remove the signal generator from J-101 and the AC VTVM from the junction of CR-103 and R-122.

Normal Indication:

5 μv (10 μv for CNP-89) maximum input for 0.6 VAC noise limiter output on all channels.

NOTE: The nominal inputs indicated above may vary widely among individual Panel Units, depending on the AVC threshold characteristic. Therefore, the nominal input figures should be considered representative only.

5-E,8. Sensitivity and Audio Output.

Procedure:

a. Connect the audio wattmeter to the speaker output.

b. Connect signal generator to J-101. Set the signal generator to the 118 Mc to 136 Mc range, 1000 cps 30% modulation.

CAUTION—Do not key the transmitter. To do so may damage the signal generator.

c. Set the fractional Mc selector to the 0.00 position. Set the Mc selector to the 118 position. Set the signal generator to 118.00 Mc. Note the input required to produce a 6 db difference between signal plus noise and noise.

d. Set the fractional Mc selector to the 0.50 position. Set the Mc selector to the 126 position. Set the signal generator to 126.50 Mc. Note the input required to produce a 6 db difference between signal plus noise and noise.

e. Set the fractional Mc selector to the 0.90 position. Set the Mc selector to the 135 position (126 for the 90 channel version). Set the signal generator to 135.90 Mc (126.90 Mc for the 90 channel version). Note the input required to produce a 6 db difference between signal plus noise and noise.

f. Remove the signal generator from J-101, and the audio wattmeter from the speaker output.

Normal Indication:

2 μv maximum input for 6 db signal plus noise to noise, at the speaker output.

5 μv maximum input for 3 (2 watts for CNP-89) watts at the speaker output.

5-E,9. Automatic Volume Control (AVC).

AVC is developed as soon as a signal is detected. To determine if the AVC threshold is occuring at its proper point, measure the DC potential at the junction of R-123 and CR-102. This potential, with no signal applied, should be 0.00 VDC ±0.2 VDC.

In the event this potential is more positive than 0.2 VDC, shunt R-120 with a value of resistance, not less than 6.8K ohms, that adjusts the potential to its proper level.

In the event this potential is more negative than 0.2 VDC, shunt R-117 with a value of resistance, not less than 560K ohms, that adjusts the potential to its proper level.

The AVC characteristic is such that a change of signal input level from 10 uv to 10K uv should produce a maximum of 4 db increase in the audio output.

5-F. NAVIGATION RECEIVER ALIGNMENT.

Reference: Schematic Fig. 11, page 55.

5-F,1. Low Frequency IF Amplifier.

Procedure:

a. Connect AC VTVM to the junction of R-316, R-333, and C-330.

b. Remove all connections from Pin 1, V-303. Connect a 47 ohm resistor from Pin 1, V-303 to ground, and connect the signal generator to Pin 1, V-303. Set the signal generator to 1.425 Mc, 400 cps 30% modulation. Increase the signal generator output for a usable indication on the AC VTVM.

c. Set the signal generator to 1.415 Mc and tune the primary and secondary tuning slugs of T-302 and T-303 for maximum indication on the AC VTVM.

d. Set the signal generator to 1.435 Mc and tune the primary and secondary tuning slugs of T-302 and T-303 for maximum indication on the AC VTVM.

e. Repeat steps c. and d. until no further increase in AC VTVM indication is obtained and peak amplitudes are approximately equal with approximately 20 Kc peak separation. The hole depth between the two peaks should be approximately 1.0 db.

f. Figure 3, page 30, illustrates the low frequency IF response.

g. Remove the signal generator and the 47 ohm resistor from Pin 1, V-303, and reconnect the components previously removed. Remove the AC VTVM from the junction of R-316, R-333, and C-330.

Normal Indication:

350 μv maximum input for 1.9 VAC detector output.

5-F,2. Selectivity—Low Frequency IF Bandwidth.

Procedure:

a. Connect AC VTVM to the junction of R-316, R-333, and C-330.

b. Remove all connections from Pin 1, V-303. Connect a 47 ohm resistor from Pin 1, V-303 to ground, and connect the Signal Generator to Pin 1, V-303. Set the signal generator to 1.425 Mc 400 cps 30% modulation. Adjust the signal generator output to produce a usable indication on the AC VTVM.

c. Vary the signal generator frequency across the LF IF response. It will be noted that the IF response peaks approximately 10 Kc either side of 1.425 Mc, with 1.425 Mc falling at the bottom of a "hole" or "dip" in the response between the two peaks. See Figure 3, page 30, for the low frequency IF response. Use the AC VTVM indication at this "hole" in the response, at 1.425 Mc, as the reference level to measure bandwidth.

d. With the reference level set, increase the signal generator output 6 db (2:1). Tune the signal generator frequency below 1.425 Mc until the reference level is obtained on the AC VTVM. Note this frequency. Tune the signal generator frequency above 1.425 Mc until the reference level is obtained on the AC VTVM. Note this frequency. The difference between the two noted frequencies is the total 6 db bandwidth.

e. With the reference level set, increase the signal generator output 60 db (1000:1). Tune the signal generator frequency below 1.425 Mc until the reference level is obtained on the AC VTVM. Note this frequency. Tune the signal generator frequency above 1.425 Mc until the reference level is obtained on the AC VTVM. Note this frequency. The difference between the two noted frequencies is the total 60 db bandwidth.

f. Remove the signal generator and the 47 ohm resistor from Pin 1, V-303, and reconnect the components previously removed. Remove the AC VTVM from the junction of R-316, R-333 and C-330.

Normal Indication:

6 DB— 40 Kc minimum total bandwidth
60DB—200 Kc maximum total bandwidth

5-F,3. HF IF Amplifier.

Procedure:

a. Disconnect Pin 5, V-303 from T-301. See Figure 1, page 30, for dummy detector circuit. Connect the dummy detector as follows.

1. Connect the *B*+ lead to +160 VDC.
2. Connect the *Plate* lead to Pin 5, V-303.
3. Connect the *A*+ lead to 13.75 VDC.
4. Connect AC VTVM to the dummy detector output.

b. Remove all connections from Pin 1, V-302. Connect a 47 ohm resistor from Pin 1, V-302 to ground. Connect signal generator to Pin 1, V-302. Set the signal generator to a range covering 12 Mc, 400 cps 30% modulation.

c. Disconnect C-316 from C-344 and then ground disconnected end of C-316.

d. Set the fractional Mc selector to the 0.9 position. Set the signal generator to 12.35 Mc and adjust its output level for a usable indication on the AC VTVM. Adjust the primary and secondary tuning slugs of T-301 for maximum indication on the AC VTVM.

e. Set the fractional Mc selector to the 0.0 position. Set the signal generator to 11.45 Mc. Adjust C-314 and C-318 for maximum indication on the AC VTVM.

f. Repeat steps d. and e. until no further increase in AC VTVM indication is obtained.

g. Check the frequency at which the maximum indication on the AC VTVM is obtained on each fractional Mc selector position. This frequency should be no more than ±15 Kc from that position's center frequency.

h. Disconnect the AC VTVM and remove the dummy detector from Pin 5, V-303. Reconnect Pin 5, V-303 to T-302. Remove C-316 from ground and reconnect it to C-344. Remove the signal generator and the 47 ohm resistor from Pin 1, V-302 and connect the components previously removed.

Normal Indication:

Each fractional Mc position should be no more than ±15 Kc from its center frequency.

5-F,4. Low Frequency Oscillator.

PRIMARY METHOD

Procedure:

a. Determine that the HF IF is properly aligned.

b. Disconnect Pin 5, V-303 from T-302. Connect a 39 uhy choke from Pin 6, V-303 to Pin 5, V-303. Connect a 47 uufd 500V capacitor from Pin 5, V-303 to the input of the frequency counter. Remove all connections from Pin 1, V-302.

c. Set L-314 to mid-range. (Tuning screw half way in). Set C-345 to mid-range. (Slot for tuning tool horizontal with respect to the chassis).

d. Set the fractional Mc selector to the 0.9 position. Observe the frequency indicated on the counter. Adjust L-314 for an indication of 10.925 Mc on the counter.

e,. Set the fractional Mc selector to the 0.0 position. Observe the frequency indicated on the counter. Adjust C-345 for an indication of 10.025 Mc on the counter.

f. Repeat steps d. and e. until the circuit is tracked. Check the frequency of each fractional Mc position. The frequency must be within ±8 Kc of the center frequency for each position. See Table IV, page 30.

g. Reconnect the components previously removed from Pin 1, V-302. Remove the counter, 47 uufd capacitor, and 39 uhy choke from Pin 5 and Pin 6 of V-103. Reconnect Pin 5, V-303 to T-302.

ALTERNATE METHOD

Procedure:

a. Calibrate a BC-221 frequency meter to the nearest crystal check point related to the 10 Mc through 11 Mc range.

b. Connect a length of insulated wire (#22 hook up wire is adequate) to the antenna post of the BC-221. Insert the other end of the wire into the plate and screen area of V-303. Take care that the wire is well away from the control grid area of V-303 or oscillator frequency pulling will be experienced.

c. Set the fractional Mc selector to the 0.9 position. Set the BC-221 to 10.925 Mc. Adjust L-314 for a zero beat from the BC-221.

d. Set the fractional Mc selector to the 0.0 position. Set the BC-221 to 10.025 Mc. Adjust C-345 for a zero beat from the BC-221.

e. Repeat steps c. and d. until the circuit is tracked. Check the frequency of each fractional Mc position. The frequency must be within ±8 Kc of the center frequency for each position.

Normal Indication:

Each fractional Mc position must be no more than ±8 Kc from its center frequency.

5-F,5. Overall IF Gain.

Procedure:

a. Connect the AC VTVM to the junction of R-316, R-333 and C-330.

b. Remove all connections from Pin 1, V-302. Connect a 47 ohm resistor from Pin 1, V-302 to ground. Connect the signal generator to Pin 1, V-302. Set the signal generator to the 11 Mc through 13 Mc range, 1000 cps 30% modulation.

c. Set the fractional Mc selector to the 0.0 position. Set the signal generator to 11.45 Mc. Note the input required to produce 1.9 VAC as indicated on the AC VTVM.

d. Set the fractional Mc selector to the 0 5 position. Set the signal generator to 11.95 Mc. Note the input required to produce 1.9 VAC as indicated on the AC VTVM.

e. Set the fractional Mc selector to the 0.9 position. Set the signal generator to 12.35 Mc. Note the input required to produce 1.9 VAC as indicated on the AC VTVM.

f. A signal input of 20 uv maximum should produce 1.9 VAC detector output on all fractional Mc positions.

g. Remove the signal generator and the 47 ohm resistor from Pin 1, V-302, and reconnect the components previously removed. Remove the AC VTVM from the junction of R-316, R-333, and C-330.

Normal Indication:

20 μv maximum input for 1.9 VAC detector output.

5-F,6. High Frequency Oscillator.

Procedure:

a. Connect a DC VTVM through a 1 megohm resistor to Pin 2, V-305A.

b. Set the Mc selector to the 108 position. Adjust C-335 for minimum positive DC voltage indicated on the VTVM.

c. Set the Mc selector to the 117 position. Adjust L-309 for minimum positive DC voltage indicated on the VTVM.

d. Repeat steps b. and c. until no further decrease in positive DC voltage can be obtained.

e. Upon completion of step d., back the tuning screw at L-309 out (ccw) ¼ turn. Also back the tuning screw of C-335 out (ccw) ½ turn.

f. Check the positive DC voltage indicated on the VTVM for each Mc selector position (108 through 117). The DC level should be +5 to +8 volts.

g. Note that the non-oscillating potential on Pin 2, V-305A is approximately 13 VDC.

h. Remove the VTVM and the 1 megohm resistor Pin 2, V-305A.

Normal Indication:

+5 to +8 VDC on Pin 2, V-305A from 108 Mc through 117 Mc.

5-F,7. High Frequency Oscillator Conversion Gain.

Procedure:

a. Connect AC VTVM to the junction of R-316, R-333 and C-330.

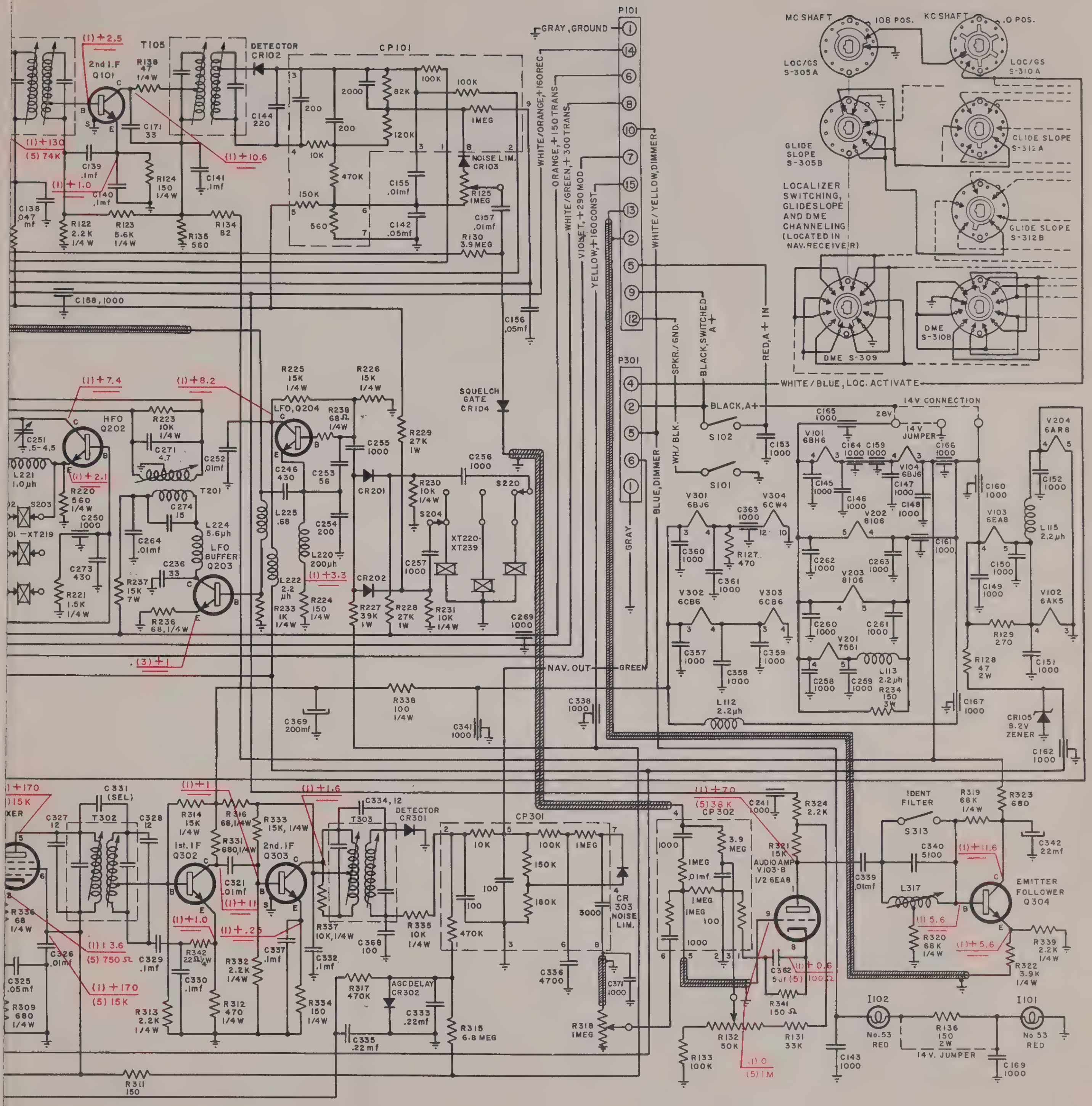
b. Remove all connections, except C-310, from Pin 1, V-302. Connect a 47 ohm resistor from Pin 1, V-302 to ground, and connect the signal generator to Pin 1, V-302. Set the signal generator to the 108 Mc to 118 Mc range, 1000 cps 30% modulation.

c. Set the fractional Mc Selector to the 0.0 position. Set the Mc Selector to the 108 position. Set the Signal Generator to 108.0 Mc. Note the input level required to produce 1.9 VAC as indicated on the AC VTVM.

d. Set the fractional Mc selector to the 0.5 position. Set the Mc selector to the 112 position. Set the signal generator to 112.5 Mc. Note the input level required to produce 1.9 VAC as indicated on the AC VTVM.

e. Set the fractional Mc selector to the 0.9 position. Set the Mc selector to the 117 position. Set the Signal Generator to 117.9 Mc. Note the input level required to produce 1.9 VAC as indicated on the AC VTVM.

f. A signal input of 80 μv maximum should produce 1.9 VAC detector level on all channels.


P101
GRAY, GROUND
WHITE/ORANGE, +160 REC
ORANGE, +150 TRANS
WHITE/GREEN, +300 TRANS
VIOLET, +290 MOD
YELLOW, +160 CONST
WHITE/YELLOW, DIMMER
SPKR./GND.
BLACK, SWITCHED A+
RED, A + IN
WHITE/BLUE, LOC. ACTIVATE
BLACK, A+
14V CONNECTION
WH./BLK.
BLUE, DIMMER
GRAY
GREEN
NAV. OUT
P301
MC SHAFT
108 POS.
KC SHAFT
0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
GLIDE SLOPE S-312B
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-310B
DME S-309
T105
2nd I.F Q101
R138 47 1/4W
DETECTOR CR102
CP101
C144 220
C171 33
100K
82K
2000
200
120K
IMEG
NOISE LIM. CR103
R125 IMEG
C155 .01mf
C157 .01mf
C142 .05mf
R130 3.9MEG
470K
150K
560
10K
C139 .1mf
C140 .1mf
C141 .1mf
R124 150 1/4W
C138 .047 mf
R122 2.2K 1/4W
R123 5.6K 1/4W
R135 560
R134 82
C158, 1000
C156 .05mf
(1) +2.5
(1) +130
(5) 74K
(1) +1.0
(1) +10.6
HFO Q202
C251 .5-4.5
L221 1.0µh
R223 10K 1/4W
C271 4.7
C252 .01mf
(1) +7.4
(1) +8.2
(1) +2.1
R220 560 1/4W
C250 1000
S203
XT219
C273 430
R221 1.5K 1/4W
T201
C274 15
L224 5.6µh
C264 .01mf
C236 33
LFO BUFFER Q203
R237 15K 7W
R236 68, 1/4W
(3) +1
LFO, Q204
R225 15K 1/4W
R226 15K 1/4W
R238 68Ω 1/4W
C255 1000
R229 27K 1W
C246 430
C253 56
L225 .68
C254 200
L220 200µh
(1) +3.3
L222 2.2 µh
R233 1K 1/4W
R224 150 1/4W
SQUELCH GATE CR104
CR201
CR202
R230 10K 1/4W
S204
C256 1000
S220
XT220-XT239
C257 1000
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
C369 200mf
R338 100 1/4W
C341 1000
C338 1000
V101 6BH6
C165 1000
28V
14V JUMPER
S102
C153 1000
S101
C164 1000
C159 1000
C166 1000
V104 6BJ6
C145 1000
C146 1000
C147 1000
C148 1000
V202 8106
V301 6BJ6
V304 6CW4
C363 1000
R127 470
C360 1000
C361 1000
C262 1000
V203 8106
C263 1000
C161 1000
V302 6CB6
V303 6CB6
C260 1000
C261 1000
V201 7551
L113 2.2µh
C357 1000
C358 1000
C359 1000
C258 1000
C259 1000
R234 150 3W
L112 2.2µh
C167 1000
V204 6AR8
C152 1000
C160 1000
V103 6EA8
L115 2.2µh
C150 1000
C149 1000
V102 6AK5
R129 270
R128 47 2W
C151 1000
CR105 8.2V ZENER
C162 1000
(1) +170
(1) 15K
MIXER
C331 (SEL)
T302
C327 12
C328 12
R314 15K 1/4W
R316 68, 1/4W
R331 680 1/4W
R333 15K, 1/4W
1st. IF Q302
2nd. IF Q303
C321 .01mf
(1) +1
(1) +1.6
(1) +11
(1) +1.0
(1) +.25
C334, 12
T303
DETECTOR CR301
CP301
R336 68 1/4W
(1) 13.6
(5) 750Ω
C329 .1mf
C326 .01mf
(1) +170
(5) 15K
C325 .05mf
R309 680 1/4W
R342 22Ω 1/4W
C330 .1mf
R332 2.2K 1/4W
C337 .1mf
R313 2.2K 1/4W
R312 470 1/4W
R334 150 1/4W
R337 10K, 1/4W
C332 .1mf
C368 100
R335 10K 1/4W
10K
100K
IMEG
150K
180K
100
470K
CR 303 NOISE LIM.
3000
C336 4700
C371 1000
R317 470K
AGC DELAY CR302
C333 .22mf
C335 .22mf
R315 6.8 MEG
R318 IMEG
R311 150
(1) +70
(5) 38K
CP302
C241 1000
R324 2.2K
3.9 MEG
R321 15K
AUDIO AMP V103-B 1/2 6EA8
.01mf
C362 5uf
(1) +0.6
(5) 100Ω
R341 150Ω
R132 50K
R131 33K
R133 100K
(1) 1.0
(5) 1M
IDENT FILTER
S313
R319 68K 1/4W
R323 680
C342 22mf
C339 .01mf
C340 5100
(1) +11.6
L317
(1) 5.6
R320 68K 1/4W
(1) +5.6
EMITTER FOLLOWER Q304
R339 2.2K 1/4W
R322 3.9K 1/4W
C143 1000
I102 No.53 RED
R136 150 2W
14V. JUMPER
C169 1000
I101 No 53 RED

A NOTES

AGE, REFERENCED TO GROUND, RECEIVE MODE, NO SIGNAL.

AGE, REFERENCED TO GROUND, RECEIVE MODE, 20µv SIGNAL.

AGE, REFERENCED TO GROUND, TRANSMIT MODE.

AGE, REFERENCED TO GROUND, TRANSMIT MODE, I MEGOHM RESISTOR
S WITH VTVM PROBE.

NCE TO GROUND, POWER OFF.

Figure 29.
Schematic, ***narco*** Mark 12A,
PANEL UNIT
for CN144-A-11.
- 71 - Extension.

b. Connect a length of insulated wire (#22 hook up wire is adequate) to the antenna post of the BC-221. Insert the other end of the wire into the plate and screen area of V-303. Take care that the wire is well away from the control grid area of V-303 or oscillator frequency pulling will be experienced.

c. Set the fractional Mc selector to the 0.9 position. Set the BC-221 to 10.925 Mc. Adjust L-314 for a zero beat from the BC-221.

d. Set the fractional Mc selector to the 0.0 position. Set the BC-221 to 10.025 Mc. Adjust C-345 for a zero beat from the BC-221.

e. Repeat steps c. and d. until the circuit is tracked. Check the frequency of each fractional Mc position. The frequency must be within ±8 Kc of the center frequency for each position.

Normal Indication:

Each fractional Mc position must be no more than ±8 Kc from its center frequency.

5-F,5. Overall IF Gain.

Procedure:

a. Connect the AC VTVM to the junction of R-316, R-333 and C-330.

b. Remove all connections from Pin 1, V-302. Connect a 47 ohm resistor from Pin 1, V-302 to ground. Connect the signal generator to Pin 1, V-302. Set the signal generator to the 11 Mc through 13 Mc range, 1000 cps 30% modulation.

c. Set the fractional Mc selector to the 0.0 position. Set the signal generator to 11.45 Mc. Note the input required to produce 1.9 VAC as indicated on the AC VTVM.

d. Set the fractional Mc selector to the 0.5 position. Set the signal generator to 11.95 Mc. Note the input required to produce 1.9 VAC as indicated on the AC VTVM.

e. Set the fractional Mc selector to the 0.9 position. Set the signal generator to 12.35 Mc. Note the input required to produce 1.9 VAC as indicated on the AC VTVM.

f. A signal input of 20 uv maximum should produce 1.9 VAC detector output on all fractional Mc positions.

g. Remove the signal generator and the 47 ohm resistor from Pin 1, V-302, and reconnect the components previously removed. Remove the AC VTVM from the junction of R-316, R-333, and C-330.

Normal Indication:

20 μv maximum input for 1.9 VAC detector output.

5-F,6. High Frequency Oscillator.

Procedure:

a. Connect a DC VTVM through a 1 megohm resistor to Pin 2, V-305A.

b. Set the Mc selector to the 108 position. Adjust C-335 for minimum positive DC voltage indicated on the VTVM.

c. Set the Mc selector to the 117 position. Adjust L-309 for minimum positive DC voltage indicated on the VTVM.

d. Repeat steps b. and c. until no further decrease in positive DC voltage can be obtained.

e. Upon completion of step d., back the tuning screw at L-309 out (ccw) ¼ turn. Also back the tuning screw of C-335 out (ccw) ½ turn.

f. Check the positive DC voltage indicated on the VTVM for each Mc selector position (108 through 117). The DC level should be +5 to +8 volts.

g. Note that the non-oscillating potential on Pin 2, V-305A is approximately 13 VDC.

h. Remove the VTVM and the 1 megohm resistor Pin 2, V-305A.

Normal Indication:

+5 to +8 VDC on Pin 2, V-305A from 108 Mc through 117 Mc.

5-F,7. High Frequency Oscillator Conversion Gain.

Procedure:

a. Connect AC VTVM to the junction of R-316, R-333 and C-330.

b. Remove all connections, except C-310, from Pin 1, V-302. Connect a 47 ohm resistor from Pin 1, V-302 to ground, and connect the signal generator to Pin 1, V-302. Set the signal generator to the 108 Mc to 118 Mc range, 1000 cps 30% modulation.

c. Set the fractional Mc Selector to the 0.0 position. Set the Mc Selector to the 108 position. Set the Signal Generator to 108.0 Mc. Note the input level required to produce 1.9 VAC as indicated on the AC VTVM.

d. Set the fractional Mc selector to the 0.5 position. Set the Mc selector to the 112 position. Set the signal generator to 112.5 Mc. Note the input level required to produce 1.9 VAC as indicated on the AC VTVM.

e. Set the fractional Mc selector to the 0.9 position. Set the Mc selector to the 117 position. Set the Signal Generator to 117.9 Mc. Note the input level required to produce 1.9 VAC as indicated on the AC VTVM.

f. A signal input of 80 μv maximum should produce 1.9 VAC detector level on all channels.

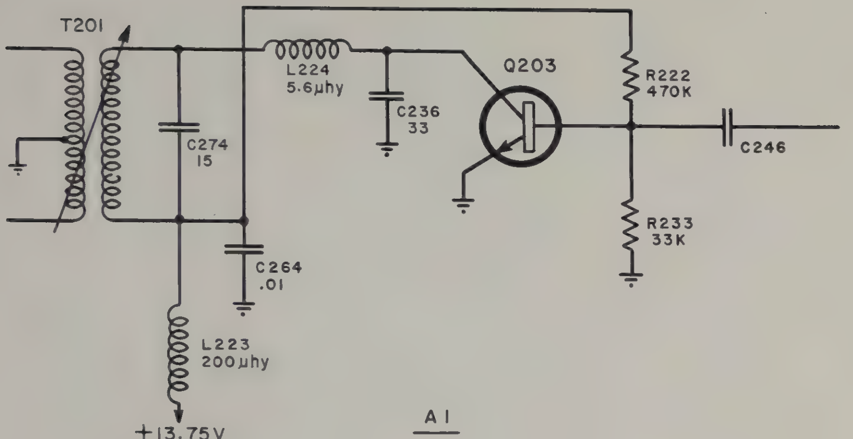

T201
L224
5.6µhy
Q203
R222
470K
C246
C274
15
C236
33
R233
33K
C264
.01
L223
200µhy
+13.75V.
FILAMENT BUSS
A1

Figure 29A.
Q-203 Circuit for Chassis Number CN144A1

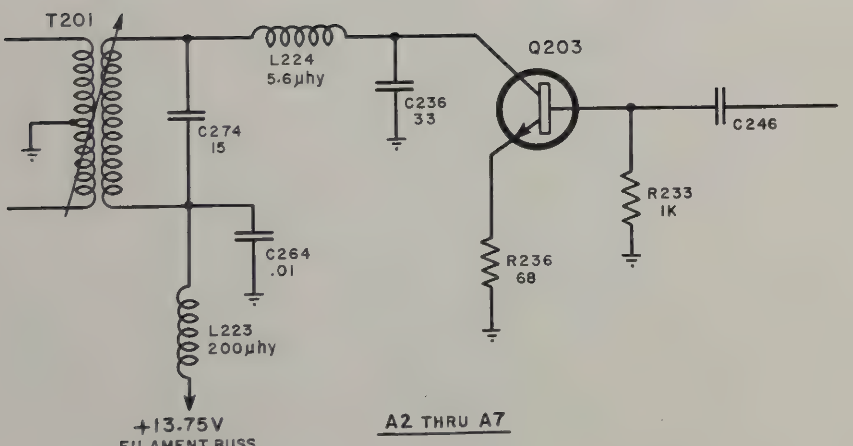
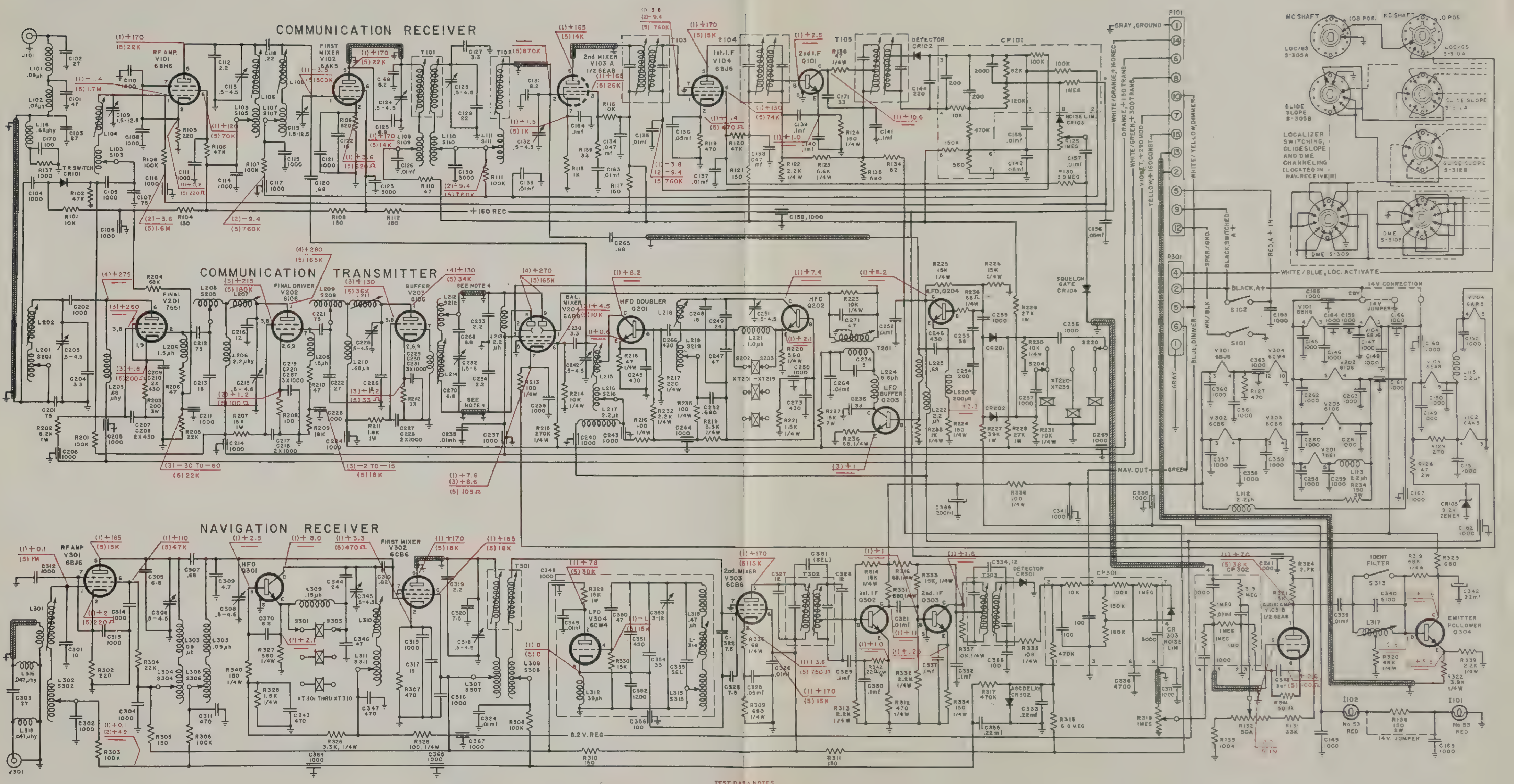
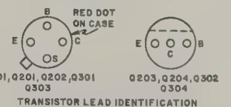

T201
L224
5.6µhy
Q203
C236
33
C246
C274
15
R233
1K
C264
.01
R236
68
L223
200µhy
+13.75V
FILAMENT BUSS
A2 THRU A7

Figure 29B.
Q-203 Circuit for Chassis Numbers CN144A2 thru A7


COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
J101
J301
P101
P301
CP101
CP301
8.2 V. REG
+160 REC
NAV. OUT
WHITE/BLUE, LOC. ACTIVATE
GRAY, GROUND
SQUELCH GATE CR104
EMITTER FOLLOWER Q304
IDENT FILTER
DME 5-309
DME 5-308
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV.RECEIVER)
14V CONNECTION
14V. JUMPER

NOTES:
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 5 7/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.


B
RED DOT ON CASE
E
C
S
Q101, Q201, Q202, Q301
Q303
E
C
B
Q203, Q204, Q302
Q304

TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

TEST DATA

DC VOLTAGE
RESISTANCE

TEST DATA NOTES
(1) DC VOLTAGE, REFERENCED TO GROUND, RECEIVE MODE, NO SIGNAL.
(2) DC VOLTAGE, REFERENCED TO GROUND, RECEIVE MODE, 20µv SIGNAL.
(3) DC VOLTAGE, REFERENCED TO GROUND, TRANSMIT MODE.
(4) DC VOLTAGE, REFERENCED TO GROUND, TRANSMIT MODE, 1 MEGOHM RESISTOR IN SERIES WITH VTVM PROBE.
(5) RESISTANCE TO GROUND, POWER OFF.

R-02225-C
ECN-5066
6-22-66

Figure 29.
Schematic, ***narco*** Mark 12A,
PANEL UNIT
for CN144-A-11.
- 71 - Extension.

g. Remove the signal generator and the 47 ohm resistor from Pin 1, V-302, and reconnect the components previously removed. Remove the AC VTVM from the junction of R-316, R-333, and C-330.

Normal Indication:

75 μv maximum input for 1.9 VAC detector output.

5-F,8. RF Amplifier.

Procedure:

a. Connect AC VTVM to the junction of R-316, R-333, and C-330.

b. Connect the signal generator to J-301.

c. Set the signal generator to the 108 - 118 Mc range, 1000 cps 30% modulation.

d. Set the fractional Mc selector to the 0.5 position. Set the Mc selector to the 108 position. Set the signal generator to 108.5 Mc and set its output for a usable indication on the AC VTVM. Adjust C-306 and C-308 for maximum indication on the AC VTVM.

e. Set the Mc selector to the 117 position. Set the signal generator to 117.5 Mc. Adjust L-301 for maximum indication on the AC VTVM.

f. Repeat steps d. and e. until no further increase in AC VTVM indication is obtained. Reduce the signal generator output to keep the detector level below 1.9 VAC (AVC theshold) during alignment.

g. A signal input of 2.5 μv maximum should produce 1.9 VAC detector output on all channels.

h. Remove the signal generator from J-301 and the AC VTVM from the junction of R-316, R-333, and C-330.

Normal Indication:
2.5 μv maximum input for 1.9 VAC detector output.

5-F,9. Sensitivity and Audio Output.

Procedure:

a. Connect the audio wattmeter to the speaker output.

b. Connect the signal generator to J-301. Set the signal generator to the 108 Mc to 118 Mc range, 1000 cps 30% modulation.

c. Set the fractional Mc selector to the 0.0 position. Set the Mc selector to the 108 position. Set the signal generator to 108.0 Mc. Note the input required to produce a 6 db difference between signal plus noise and noise.

d. Set the fractional Mc selector to the 0.5 position. Set the Mc selector to the 112 position. Set the signal generator to 112.5 Mc. Note the input required to produce a 6 db difference between signal plus noise and noise.

e. Set the fractional Mc selector to the 0.9 position. Set the Mc selector to the 117 position. Set the signal generator to 117.9 Mc. Note the input required to produce a 6 db difference between signal plus noise and noise.

f. A signal input of 1.3 μv maximum should produce 6 db signal plus noise to noise at the speaker output on all channels.

g. A signal input of 3 μv maximum should produce 4.5 watts at the speaker output on all channels.

h. Remove the signal generator from J-301 and the audio wattmeter from the speaker output.

Normal Indication:

1.3 μv maximum input for 6 db signal plus noise to noise at the speaker output.

3 μv maximum input for 4.5 watts at the speaker output.

5-F,10. Automatic Volume Control (AVC).

The AVC threshold, that point at which the AVC bus starts to go negative, should occur at 1.9 VAC ±0.1 VAC detector level. The detector level is measured at the junction of R-316, R-333, and C-330. The AVC threshold is controlled by R-312. Its value is selected to provide the proper amount of current to set the AVC threshold at 1.9 VAC detector level.

The AVC characteristic is such that a change of signal input level from 10 μv to 10K μv should produce a maximum of 4 db increase in the audio output.

5-G. CONVERSION, 90 to 360 COMMUNICATION CHANNELS.

5-G,1. Fractional Megacycle Crystals. EL-2051 Kit 72019-105.

a. Installation.

This kit contains ten crystals which are to be installed in the low frequency oscillator crystal assembly. The LFO crystal assembly is located just to the rear of V-103 and V-204. It will be noted that this assembly contains crystals in every other crystal position only on both the top and bottom sides of the chassis.

Viewed from the top, front, install the highest frequency crystal of this kit (9.425 Mc) in the vacant crystal space on the extreme left — *nearest chassis edge*. NOTE: Descending crystal oscillator operating frequency is also ascending channel selector frequency; i.e., 9.475 Mc = .00, 8.525 Mc = .95. Install the remaining crystals, in descending frequency order, in the vacant crystal spaces working from left to right. When the top row is completed, five crystals should have been used.

Turn the chassis over. Install the remaining five crystals in the open crystal spaces in the bottom row. Viewed from the bottom, front, install the crystals in descending frequency order working from left to right.

Use care in soldering crystal leads to prevent heat damage to the crystal. Use extreme care in soldering the crystal leads to the pads on the printed circuit to prevent lifting of the pads due to excessive heat. Do not bend crystal leads at a right angle at the point where they emerge from the crystal case. This could fracture the glass seal.

b. Detent Arrangement.

The fractional Mc detent is located at the rear of the chassis on the top side between T-101 and T-102. It will be noted that this detent has a star wheel on each end. On the one end, toward the front of the unit, a ten position star wheel; on the other end, toward the rear of the unit, a twenty position star wheel. This detent must be reversed, or turned around, so that the twenty position star wheel is toward the front of the unit.

The detent is secured by two screws, and it can be removed from its mounting shaft when these screws are loosened. Before removing the detent, set the fractional Mc selector to a position where the rotor tabs of the crystal assembly or of the HF IF step inductors can be observed. Note, at the same time, the frequency indicated by the fractional Mc dial. This is necessary so that proper indexing can be re-established easily.

Remove the detent spring and the detent roller from the detent assembly. Then loosen the two set screws in the dual star wheel assembly and slide the assembly to the rear of the Unit and off the shaft. In the event there is insufficient space to completely remove the star wheel assembly from the shaft, it will be necessary to remove the "COM" Fractional Mc Knob and loosen the set screws securing the Fractional Mc dial to its shaft. The fractional Mc shaft can then be moved forward enough to remove the star wheel assembly. Turn the star wheel assembly end for end so that the twenty position star wheel is toward the front of the unit, then slide it back on its shaft. Now replace the detent roller and detent spring. Note that the long end of the detent spring shall be retained in position, by placing this end on the inside of the outermost tab on the detent mounting plate. Check the rotor tabs at the chosen reference point for indexing, then secure the set screws in the star wheel assembly. Provide about .005 inch end play between the star wheel assembly and the bushing in the detent mounting plate. If the Fractional Mc Knob and dial have been loosened, re-secure them in their proper position as noted above.

After the final check of the assembly, a small amount of wide temperature range grease should be applied to the spring fulcrum, roller, and star wheel detent teeth.

5-G,2. Whole Megacycle Crystals. EL-2051 Kit 72019-102.

a. Installation.

This kit contains nine crystals which are to be installed in the high frequency oscillator crystal assembly. Viewed from the top, front, the HFO assembly is located on the left side approximately midway between the front and rear of the chassis. It is enclosed in a box. Remove the top and the bottom covers. Each is held in place by two machine screws.

Viewed from the front, top side, it will be noted that the HFO crystal assembly has three empty crystal spaces to the left of i's top center, and six empty crystal spaces to the right of its top center. Install these nine crystals in these spaces, in ascending frequency order working from left to right. Use care in soldering crystal leads to prevent heat damage to the crystal. It may be necessary to remove C-241 and L-218 to install crystals in the last two spaces.

b. Stop Removal.

The stop on the Mc selector detent plate at the 126 position must now be broken out. To gain access to this stop, the knobs, mask, and trim panel must be removed. Before disassembly of the front panel, it is well to set the selectors to a reference frequency position for re-assembly. Removal of the front panel assembly will reveal the detent plate. The stop will be located on the rear side at the bottom and center of the detent plate. The stop is merely a lance, approximately 1/16 of an inch wide, in the detent plate itself. Break this stop out, and the Mc selector will channel to the 135 position. Exercise care that the channel selectors indicate the proper channel when the front panel is reassembled.

5-G,3. Post Conversion Check-out.

After the crystals are installed, the detents properly adjusted, and the HFO covers re-assembled, give the radio an operational performance check. Alignment of the HFO, the transmitter, and the receiver RF section should be checked. In the event realignment is necessary, refer to the appropriate part of the alignment procedure section of the Narco Mark 12 Instuction Manual. A new fequency check slip is required for the transmitter which reflects the original plus the new channels that have been activated.

SECTION 6
ILLUSTRATIONS

6-A. INTRODUCTION.

All of the various Tables, Diagrams and Photos (except the Electrical Circuit Schematics) referred to in the preceding sections have been collected in this section for convenient reference. This arrangement was chosen in preference to the arrangement where the illustrations are located on or near the pages where the subject is discussed. Such an arrangement tends to be inconvenient and confusing when the illustration is needed to cover more than one subject.

The arrangement of this manual is such that wherever it is practical the illustrations are upright with respect to the text for convenient use.

Section 7 Replacement Parts, follows this section.

Section 8, Schematics, follows the Replacement Parts section as the last item in the Manual. The Schematics are in the form of two-page "pullout" sheets which can be used while the pages of the text, illustrations, or parts list are open for use.

6-B. TABLES.

TABLE I

CRYSTAL FREQUENCY — HFO

COMMUNICATIONS TRANSCEIVER

Channel	Oscillator Fundamental Frequency (Mc)	Oscillator Doubler Frequency (Mc)
117	63.2375	126.475
118	63.7375	127.475
119	64.2375	128.475
120	64.7375	129.475
121	65.2375	130.475
122	65.7375	131.475
123	66.2375	132.475
124	66.7375	133.475
125	67.2375	134.475
126	67.7375	135.475
127	68.2375	136.475
128	68.7325	137.475
129	69.2375	138.475
130	69.7375	139.475
131	70.2375	140.475
132	70.7375	141.475
133	71.2375	142.475
134	71.7375	143.475
135	72.2375	144.475

TABLE II

CRYSTAL FREQUENCY — LFO

COMMUNICATIONS TRANSCEIVER

Channel	Transmit Crystal Frequency (Mc)	Receive Crystal Frequency (Mc)
.00	9.475	8.975
.05	9.425	8.925
.10	9.375	8.875
.15	9.325	8.825
.20	9.275	8.775
.25	9.225	8.725
.30	9.175	8.675
.35	9.125	8.625
.40	9.075	8.575
.45	9.025	8.525
.50	8.975	9.475
.55	8.925	9.425
.60	8.875	9.375
.65	8.825	9.325
.70	8.775	9.275
.75	8.725	9.225
.80	8.675	9.175
.85	8.625	9.125
.90	8.575	9.075
.95	8.525	9.025

TABLE III
CRYSTAL FREQUENCY — HFO NAVIGATION RECEIVER

Channel	Crystal Frequency (Mc)
108	96.55
109	97.55
110	98.55
111	99.55
112	100.55
113	101.55
114	102.55
115	103.55
116	104.55
117	105.55

TABLE IV
OSCILLATOR FREQUENCY — LFO
NAVIGATION RECEIVER

Channel	Center Frequency (Mc)
.0	10.025
.1	10.125
.2	10.225
.3	10.325
.4	10.425
.5	10.525
.6	10.625
.7	10.725
.8	10.825
.9	10.925

TABLE V

P-301 Terminal No.	Wire Color	Wire Size	Circuit Function
1	Grey	#18	Ground
2	Black	#18	+ DC Supply
3	No. Conn.	—	—
4	White/ Blue Tr.	#22	Omni/Loc. Relay
5	Blue	#22	Ext. Dim. for VOR
6	Green	#22	Omni Signal

6-C. DIAGRAMS.

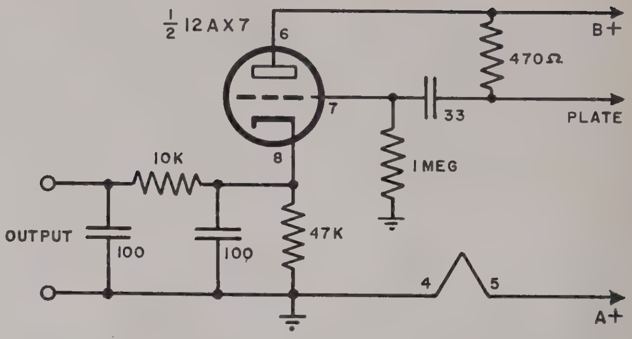


Figure 1.
TEST DETECTOR, High Impedance Type.

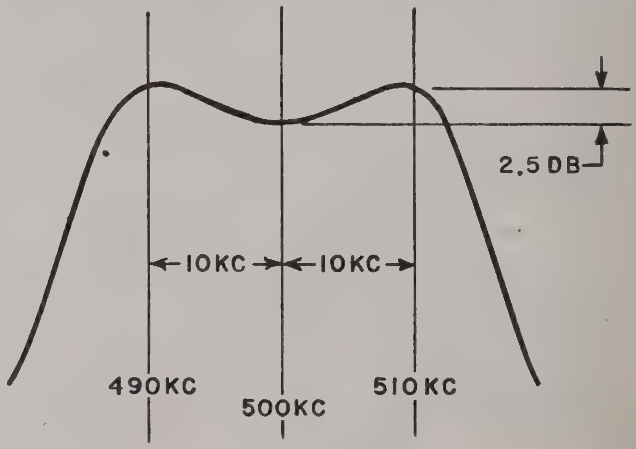


Figure 2.
narco Mark-12 COM. Receiver, L.F. I.F. Response.

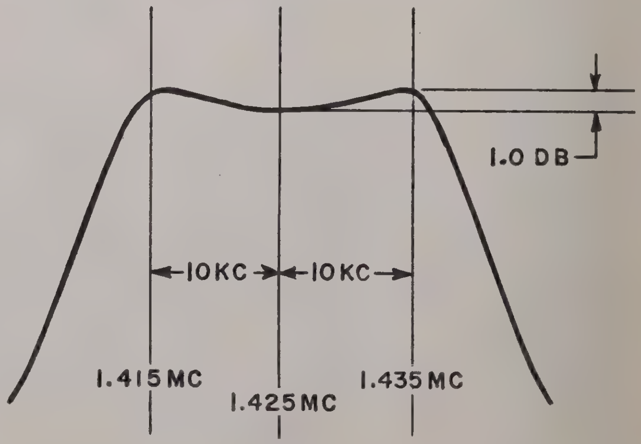
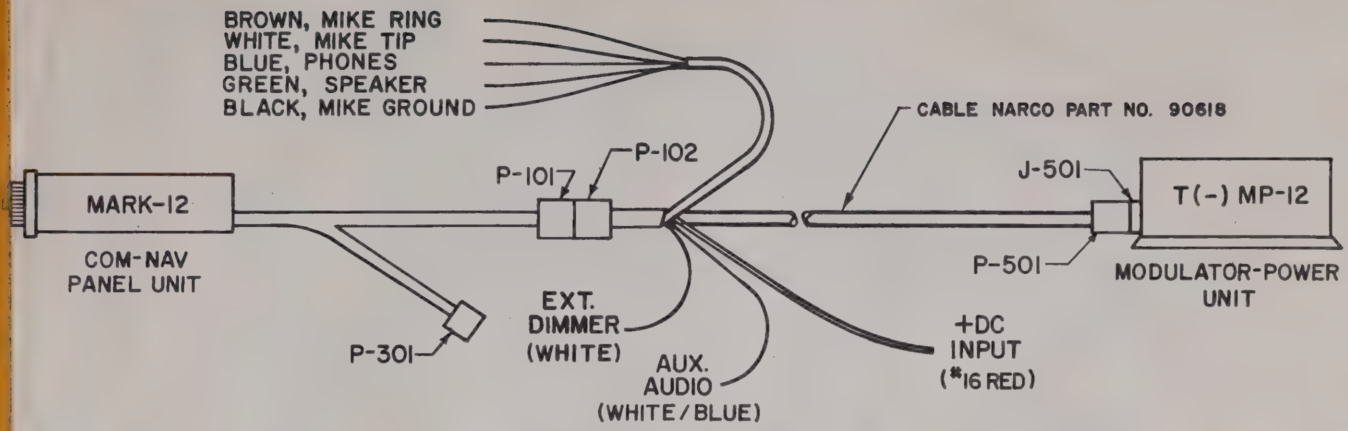
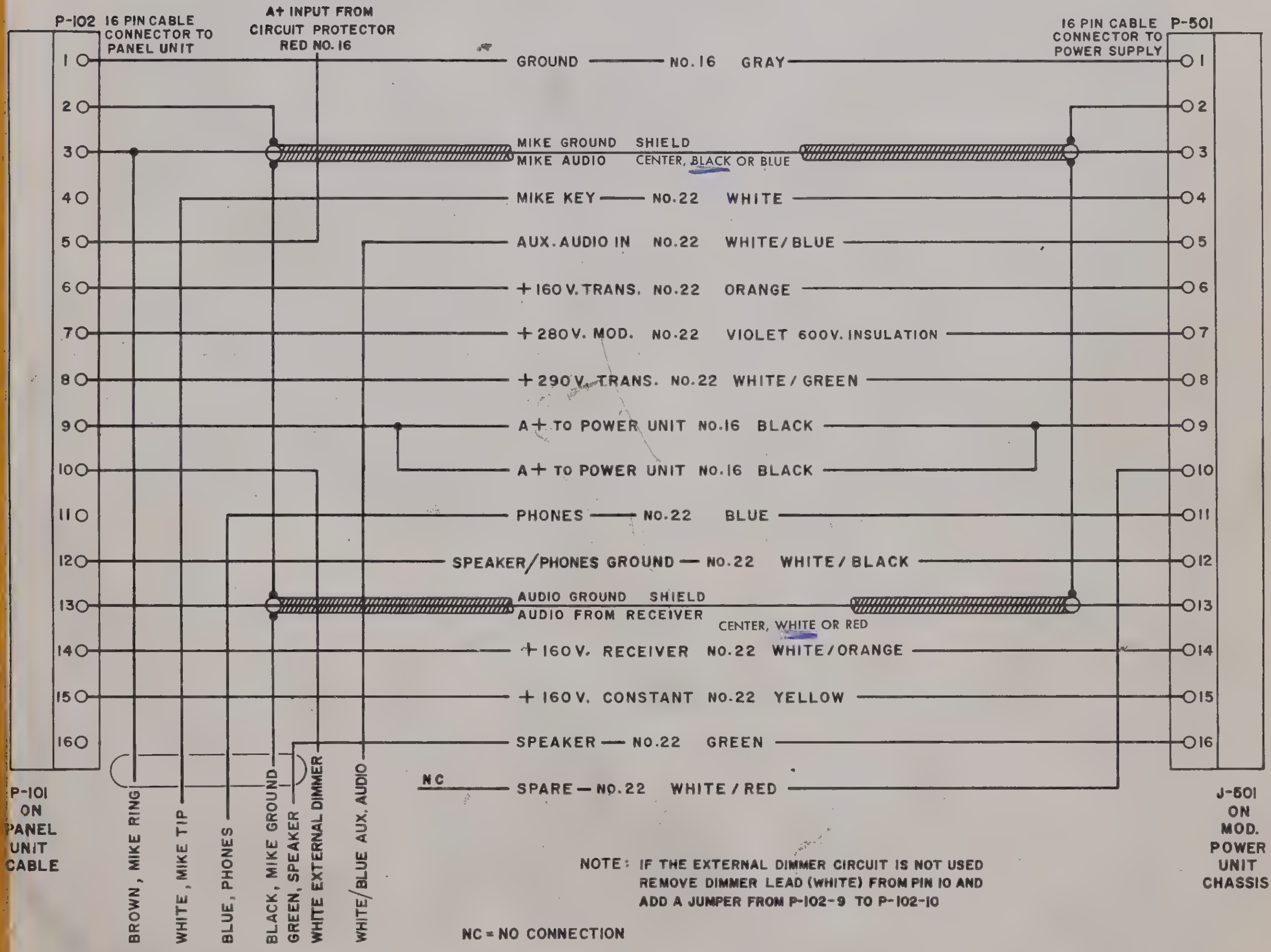


Figure 3.
narco Mark-12 NAV. Receiver. L.F. I.F. Response.


BROWN, MIKE RING
WHITE, MIKE TIP
BLUE, PHONES
GREEN, SPEAKER
BLACK, MIKE GROUND
CABLE NARCO PART NO. 90618
P-101
P-102
J-501
MARK-12
T(-) MP-12
COM-NAV
PANEL UNIT
P-501
MODULATOR-POWER
UNIT
EXT.
DIMMER
(WHITE)
P-301
AUX.
AUDIO
(WHITE/BLUE)
+DC
INPUT
(#16 RED)

NOTE - CONNECTORS ON BOTH ENDS OF CABLE 90618 ARE ALIKE BUT EQUIPMENT WILL OPERATE ONLY WHEN CABLE IS INSTALLED AS SHOWN, WITH POWER AND ACCESSORY WIRES AT PANEL UNIT END.

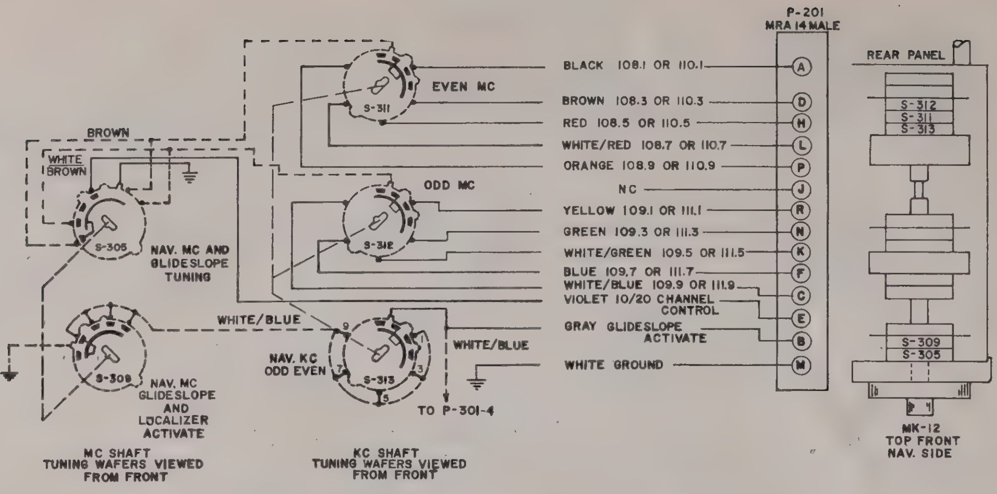
Figure 4.
narco Mark-12 INTERCONNECTING CABLE,
Power and Accessories.


P-102 16 PIN CABLE CONNECTOR TO PANEL UNIT
A+ INPUT FROM CIRCUIT PROTECTOR RED NO. 16
16 PIN CABLE CONNECTOR TO POWER SUPPLY P-501
1 GROUND NO. 16 GRAY 1
2 2
3 MIKE GROUND SHIELD
MIKE AUDIO CENTER, BLACK OR BLUE 3
4 MIKE KEY NO. 22 WHITE 4
5 AUX. AUDIO IN NO. 22 WHITE/BLUE 5
6 + 160 V. TRANS. NO. 22 ORANGE 6
7 + 280 V. MOD. NO. 22 VIOLET 600 V. INSULATION 7
8 + 290 V. TRANS. NO. 22 WHITE/GREEN 8
9 A+ TO POWER UNIT NO. 16 BLACK 9
10 A+ TO POWER UNIT NO. 16 BLACK 10
11 PHONES NO. 22 BLUE 11
12 SPEAKER/PHONES GROUND NO. 22 WHITE/BLACK 12
13 AUDIO GROUND SHIELD
AUDIO FROM RECEIVER CENTER, WHITE OR RED 13
14 + 160 V. RECEIVER NO. 22 WHITE/ORANGE 14
15 + 160 V. CONSTANT NO. 22 YELLOW 15
16 SPEAKER NO. 22 GREEN 16
NC SPARE NO. 22 WHITE/RED
P-101 ON PANEL UNIT CABLE
BROWN, MIKE RING
WHITE, MIKE TIP
BLUE, PHONES
BLACK, MIKE GROUND
GREEN, SPEAKER
WHITE EXTERNAL DIMMER
WHITE/BLUE AUX. AUDIO
J-501 ON MOD. POWER UNIT CHASSIS

NOTE: IF THE EXTERNAL DIMMER CIRCUIT IS NOT USED REMOVE DIMMER LEAD (WHITE) FROM PIN 10 AND ADD A JUMPER FROM P-102-9 TO P-102-10

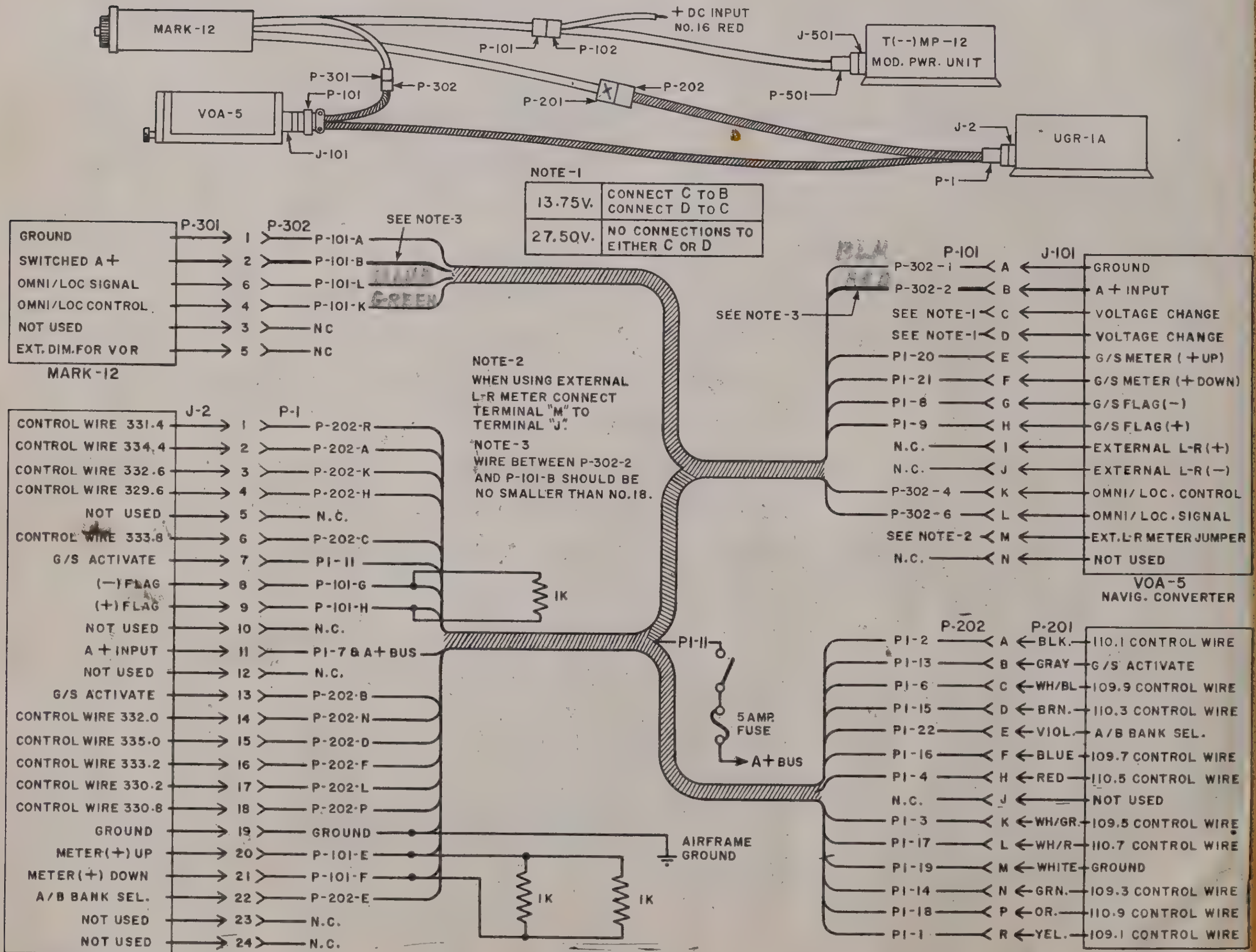
NC = NO CONNECTION

Figure 5.
narco Mark-12 CABLE CONNECTIONS,
Power and Accessories.


P-201
MRA 14 MALE
BLACK 108.1 OR 110.1
BROWN 108.3 OR 110.3
RED 108.5 OR 110.5
WHITE/RED 108.7 OR 110.7
ORANGE 108.9 OR 110.9
NC
YELLOW 109.1 OR 111.1
GREEN 109.3 OR 111.3
WHITE/GREEN 109.5 OR 111.5
BLUE 109.7 OR 111.7
WHITE/BLUE 109.9 OR 111.9
VIOLET 10/20 CHANNEL CONTROL
GRAY GLIDESLOPE ACTIVATE
WHITE GROUND
A
D
H
L
P
J
R
N
K
F
C
E
B
M
EVEN MC
S-311
ODD MC
S-312
BROWN
WHITE
BROWN
S-305
NAV. MC AND GLIDESLOPE TUNING
WHITE/BLUE
S-309
NAV. MC GLIDESLOPE AND LOCALIZER ACTIVATE
NAV. KC ODD EVEN
S-313
9
1
7
3
5
WHITE/BLUE
TO P-301-4
MC SHAFT TUNING WAFERS VIEWED FROM FRONT
KC SHAFT TUNING WAFERS VIEWED FROM FRONT
REAR PANEL
S-312
S-311
S-313
S-309
S-305
MK-12 TOP FRONT NAV. SIDE

NOTE:
DOTTED LINES AND TUNING WAFERS
DENOTE EXISTING WIRING AND
PARTS WITHIN THE SET.

Figure 6.
narco Mark-12 Glide Slope Channel Selector Switch Wiring.


MARK-12
+ DC INPUT NO. 16 RED
P-101
P-102
J-501
T(--)MP-12 MOD. PWR. UNIT
P-301
P-302
P-101
VOA-5
P-201
P-202
P-501
J-2
UGR-1A
J-101
P-1
GROUND
SWITCHED A+
OMNI/LOC SIGNAL
OMNI/LOC CONTROL
NOT USED
EXT. DIM. FOR VOR
MARK-12
P-301
P-302
1 P-101-A
2 P-101-B
6 P-101-L
4 P-101-K
3 NC
5 NC
SEE NOTE-3
GREEN
J-2
P-1
CONTROL WIRE 331.4 1 P-202-R
CONTROL WIRE 334.4 2 P-202-A
CONTROL WIRE 332.6 3 P-202-K
CONTROL WIRE 329.6 4 P-202-H
NOT USED 5 N.C.
CONTROL WIRE 333.8 6 P-202-C
G/S ACTIVATE 7 P1-11
(−) FLAG 8 P-101-G
(+) FLAG 9 P-101-H
NOT USED 10 N.C.
A + INPUT 11 P1-7 & A+ BUS
NOT USED 12 N.C.
G/S ACTIVATE 13 P-202-B
CONTROL WIRE 332.0 14 P-202-N
CONTROL WIRE 335.0 15 P-202-D
CONTROL WIRE 333.2 16 P-202-F
CONTROL WIRE 330.2 17 P-202-L
CONTROL WIRE 330.8 18 P-202-P
GROUND 19 GROUND
METER (+) UP 20 P-101-E
METER (+) DOWN 21 P-101-F
A/B BANK SEL. 22 P-202-E
NOT USED 23 N.C.
NOT USED 24 N.C.
1K
1K
1K
AIRFRAME GROUND
P1-11
5 AMP. FUSE
A+ BUS
BLK
RED
SEE NOTE-3
P-101
J-101
P-302-1 A GROUND
P-302-2 B A + INPUT
SEE NOTE-1 C VOLTAGE CHANGE
SEE NOTE-1 D VOLTAGE CHANGE
P1-20 E G/S METER (+UP)
P1-21 F G/S METER (+DOWN)
P1-8 G G/S FLAG (−)
P1-9 H G/S FLAG (+)
N.C. I EXTERNAL L-R (+)
N.C. J EXTERNAL L-R (−)
P-302-4 K OMNI/LOC. CONTROL
P-302-6 L OMNI/LOC. SIGNAL
SEE NOTE-2 M EXT. L-R METER JUMPER
N.C. N NOT USED
VOA-5
NAVIG. CONVERTER
P-202
P-201
P1-2 A BLK. 110.1 CONTROL WIRE
P1-13 B GRAY G/S ACTIVATE
P1-6 C WH/BL 109.9 CONTROL WIRE
P1-15 D BRN. 110.3 CONTROL WIRE
P1-22 E VIOL. A/B BANK SEL.
P1-16 F BLUE 109.7 CONTROL WIRE
P1-4 H RED 110.5 CONTROL WIRE
N.C. J NOT USED
P1-3 K WH/GR. 109.5 CONTROL WIRE
P1-17 L WH/R 110.7 CONTROL WIRE
P1-19 M WHITE GROUND
P1-14 N GRN. 109.3 CONTROL WIRE
P1-18 P OR. 110.9 CONTROL WIRE
P1-1 R YEL. 109.1 CONTROL WIRE

NOTE-1

13.75V.	CONNECT C TO B CONNECT D TO C
27.50V.	NO CONNECTIONS TO EITHER C OR D

NOTE-2
WHEN USING EXTERNAL L-R METER CONNECT TERMINAL "M" TO TERMINAL "J".

NOTE-3
WIRE BETWEEN P-302-2 AND P-101-B SHOULD BE NO SMALLER THAN NO. 18.

UGR-1A
GLIDE SLOPE RECEIVER

MARK-12
NAV.-RECEIVER

Figure 7.
narco Mark-12 INTERCONNECTIONS, CN-89, with *narco* VOA-5 and *narco* UGR-1A.

6-D. PHOTOS.

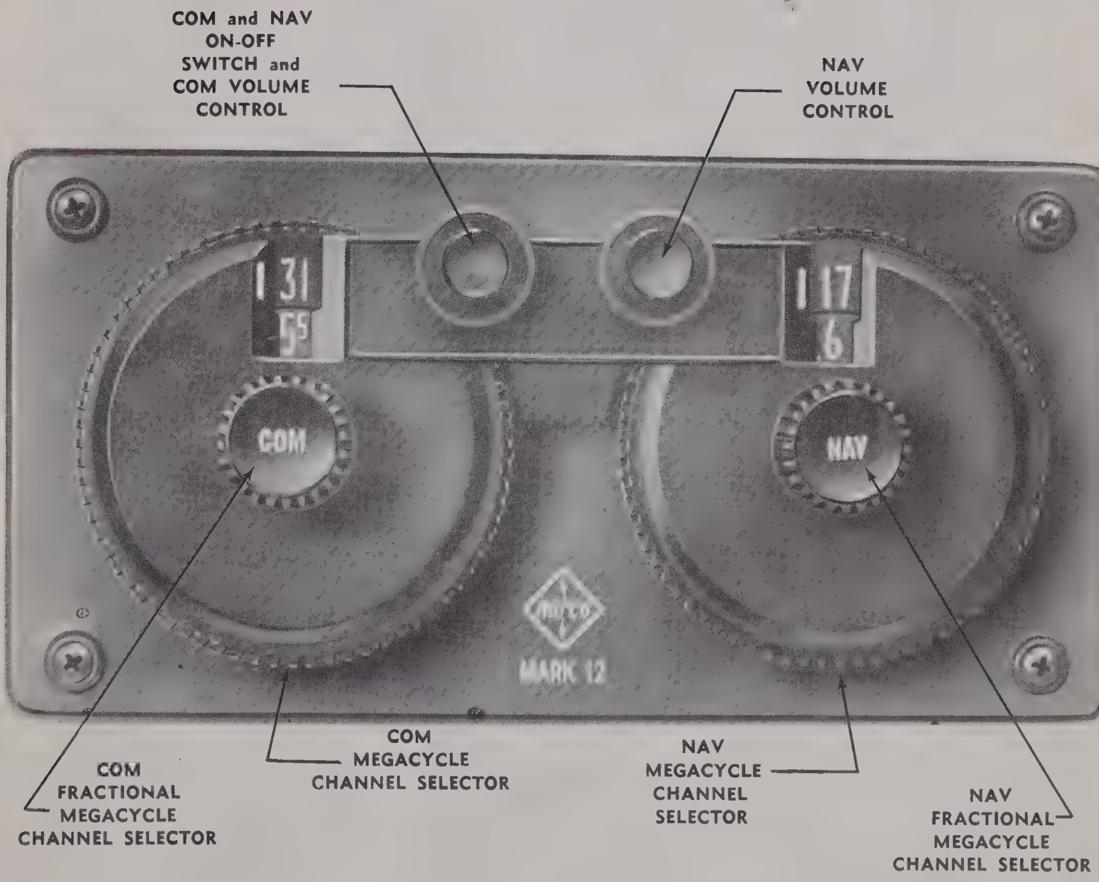

COM and NAV ON-OFF SWITCH and COM VOLUME CONTROL
NAV VOLUME CONTROL
131
55
117
6
COM
NAV
narco
MARK 12
COM FRACTIONAL MEGACYCLE CHANNEL SELECTOR
COM MEGACYCLE CHANNEL SELECTOR
NAV MEGACYCLE CHANNEL SELECTOR
NAV FRACTIONAL MEGACYCLE CHANNEL SELECTOR

Photo A.
narco Mark-12 PANEL UNIT, Front View.

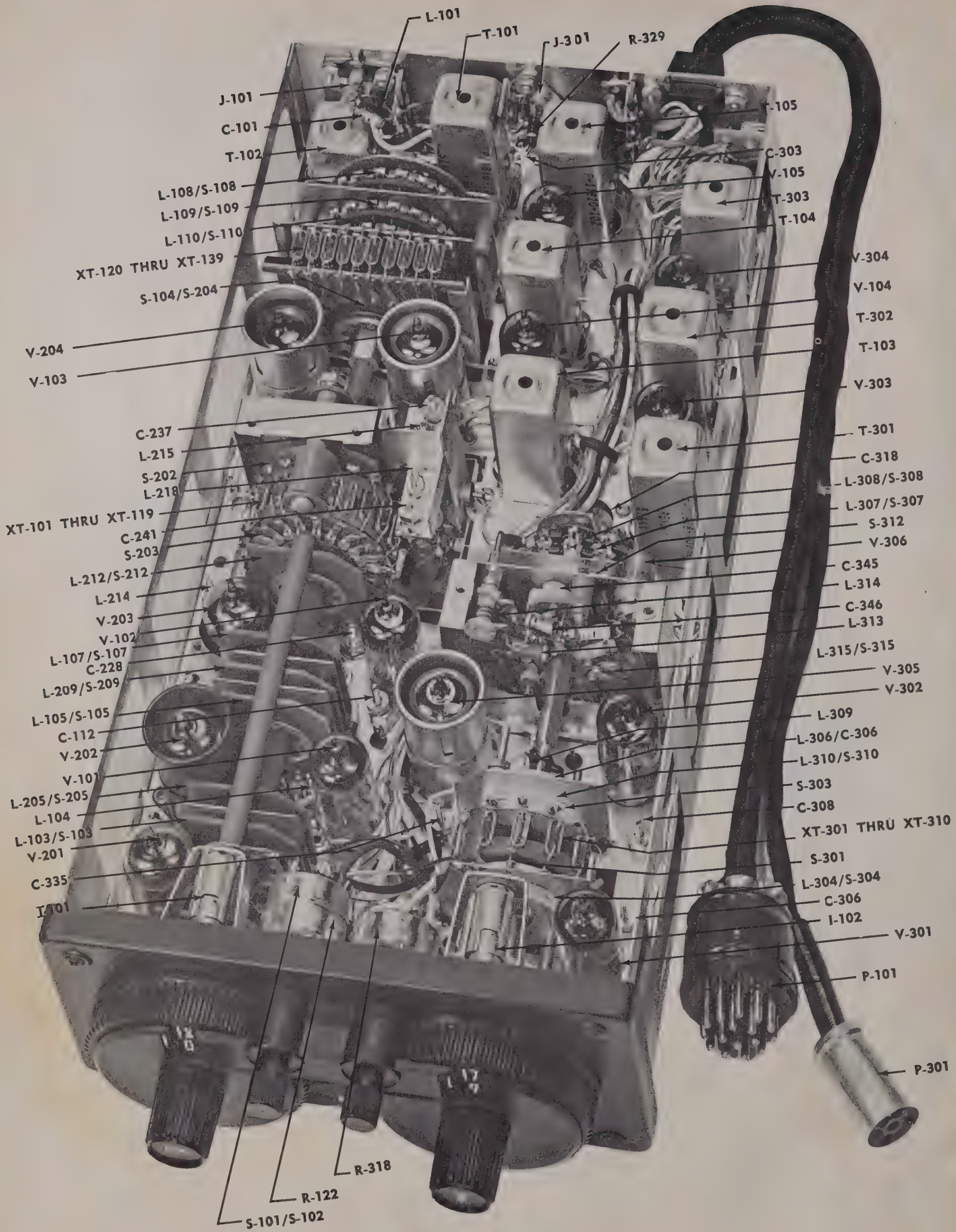

L-101
T-101
J-301
R-329
J-101
C-101
T-102
L-108/S-108
L-109/S-109
L-110/S-110
XT-120 THRU XT-139
S-104/S-204
V-204
V-103
C-237
L-215
S-202
L-218
XT-101 THRU XT-119
C-241
S-203
L-212/S-212
L-214
V-203
V-102
L-107/S-107
C-228
L-209/S-209
L-105/S-105
C-112
V-202
V-101
L-205/S-205
L-104
L-103/S-103
V-201
C-335
I-101
T-105
C-303
V-105
T-303
T-104
V-304
V-104
T-302
T-103
V-303
T-301
C-318
L-308/S-308
L-307/S-307
S-312
V-306
C-345
L-314
C-346
L-313
L-315/S-315
V-305
V-302
L-309
L-306/C-306
L-310/S-310
S-303
C-308
XT-301 THRU XT-310
S-301
L-304/S-304
C-306
I-102
V-301
P-101
P-301
R-318
R-122
S-101/S-102

Photo B.
narco Mark-12 PANEL UNIT, Top Front,
Right Side (OSC. Covers Removed), CN-89.

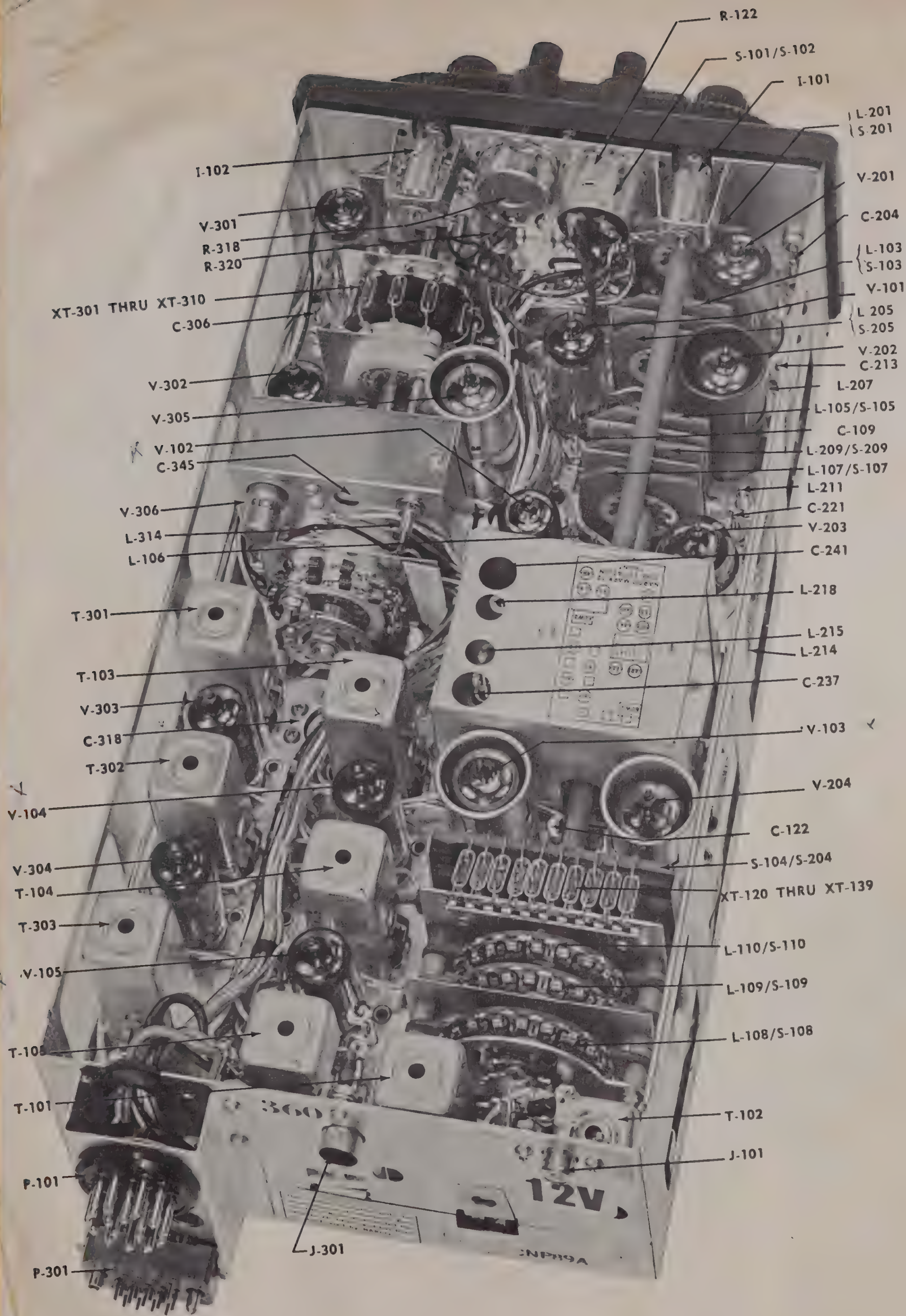
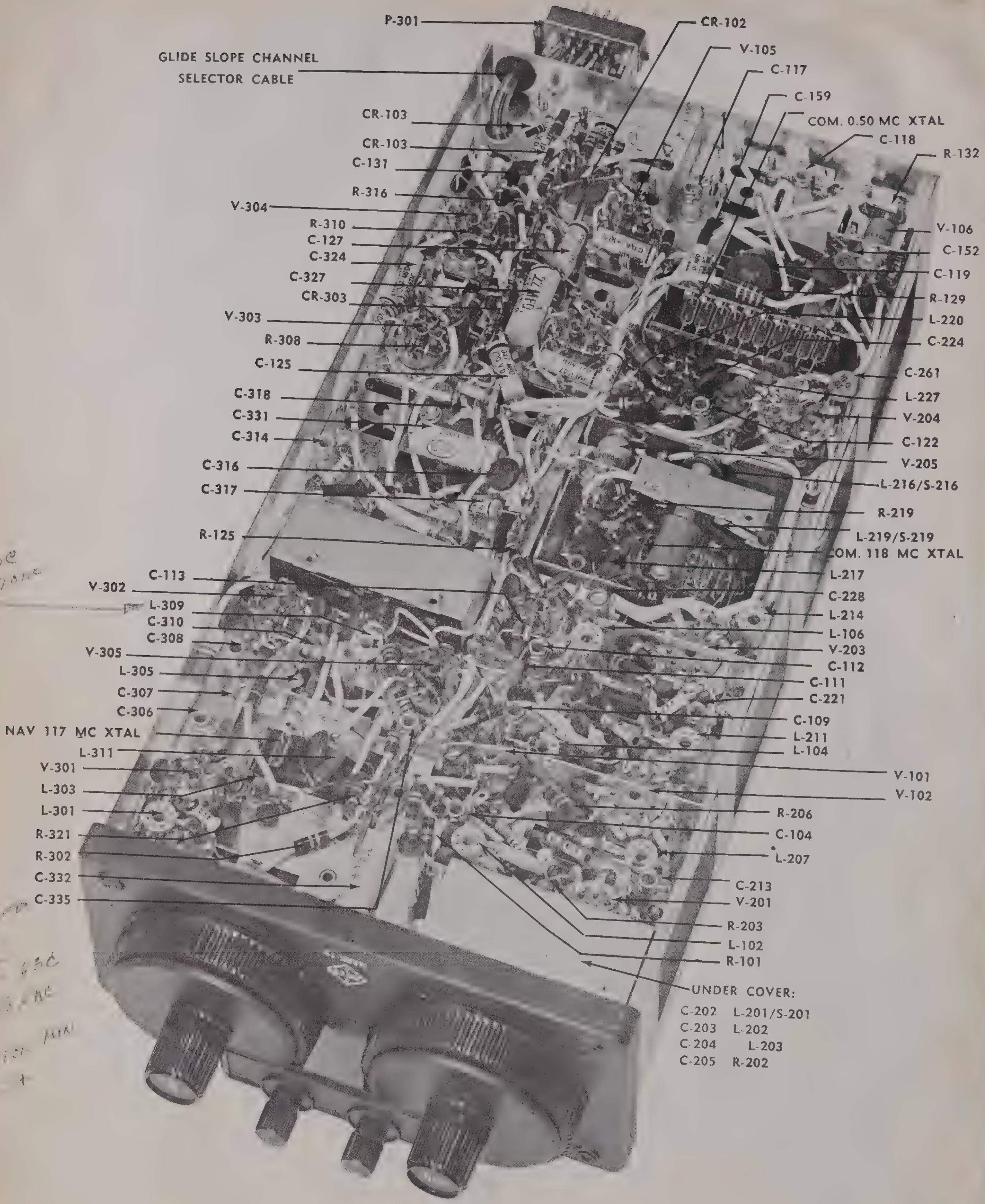

R-122
S-101/S-102
I-101
L-201
S-201
I-102
V-201
V-301
C-204
R-318
R-320
L-103
S-103
V-101
XT-301 THRU XT-310
C-306
L 205
S-205
V-202
C-213
V-302
L-207
L-105/S-105
V-305
C-109
V-102
L-209/S-209
C-345
L-107/S-107
L-211
V-306
C-221
V-203
L-314
L-106
C-241
L-218
T-301
L-215
L-214
T-103
C-237
V-303
V-103
C-318
T-302
V-204
V-104
C-122
S-104/S-204
V-304
T-104
XT-120 THRU XT-139
T-303
L-110/S-110
V-105
L-109/S-109
L-108/S-108
T-105
T-101
T-102
J-101
P-101
12V
J-301
P-301

Photo C.
narco Mark-12 PANEL UNIT, Top Rear,
Left Side, CNP-89.


P-301
GLIDE SLOPE CHANNEL SELECTOR CABLE
CR-103
CR-103
C-131
R-316
V-304
R-310
C-127
C-324
C-327
CR-303
V-303
R-308
C-125
C-318
C-331
C-314
C-316
C-317
R-125
C-113
V-302
L-309
C-310
C-308
V-305
L-305
C-307
C-306
NAV 117 MC XTAL
L-311
V-301
L-303
L-301
R-321
R-302
C-332
C-335
CR-102
V-105
C-117
C-159
COM. 0.50 MC XTAL
C-118
R-132
V-106
C-152
C-119
R-129
L-220
C-224
C-261
L-227
V-204
C-122
V-205
L-216/S-216
R-219
L-219/S-219
COM. 118 MC XTAL
L-217
C-228
L-214
L-106
V-203
C-112
C-111
C-221
C-109
L-211
L-104
V-101
V-102
R-206
C-104
L-207
C-213
V-201
R-203
L-102
R-101
UNDER COVER:
C-202 L-201/S-201
C-203 L-202
C-204 L-203
C-205 R-202

use
117.0 MC

osc
MC
MAX

Photo D.
narco Mark-12 PANEL UNIT, Bottom Front, Left Side, (OSC. Covers Removed), CNP-89.

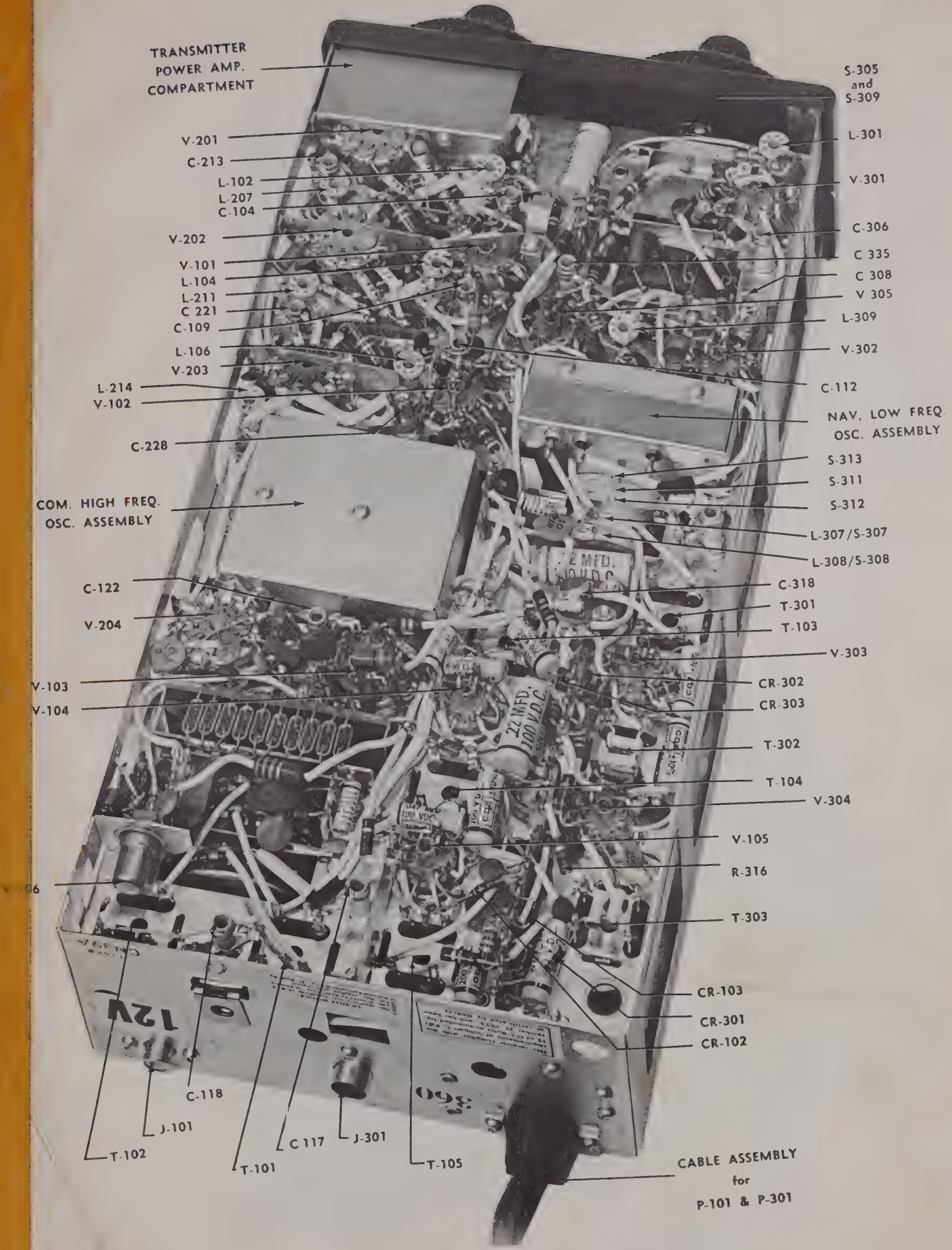

TRANSMITTER POWER AMP. COMPARTMENT
S-305 and S-309
V-201
C-213
L-102
L-207
C-104
L-301
V-301
V-202
V-101
L-104
L-211
C 221
C-109
C-306
C 335
C 308
V 305
L-309
L-106
V-203
V-302
L-214
V-102
C-112
C-228
NAV. LOW FREQ. OSC. ASSEMBLY
S-313
S-311
S-312
COM. HIGH FREQ. OSC. ASSEMBLY
L-307/S-307
L-308/S-308
C-122
C-318
T-301
V-204
T-103
V-303
V-103
CR-302
V-104
CR-303
T-302
T-104
V-304
V-105
V -06
R-316
T-303
CR-103
CR-301
CR-102
12V
C-118
J-101
T-102
T-101
C 117
J-301
T-105
CABLE ASSEMBLY for P-101 & P-301

Photo E.
narco Mark-12 PANEL UNIT, Bottom Rear,
Right Side, CN-89.

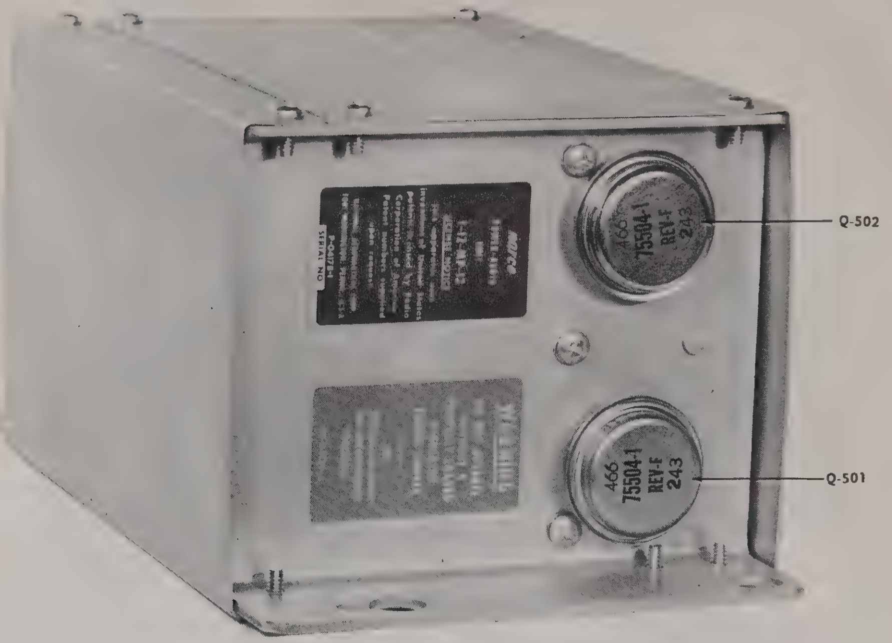

Q-502
Q-501
466
75504-1
REV-F
243

Photo F.
MODULATOR-POWER UNIT, for ***narco*** Mark-12,
T-12MP-12 or T-24MP-12, Front View, In Case.

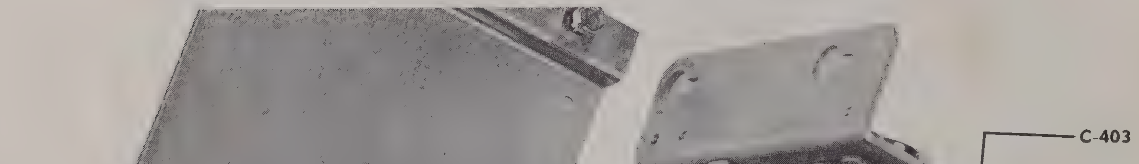

C-403
T-401
L-401
T-402
C-506
C-502
T-501
MOUNTING BASE

Photo G.
MODULATOR-POWER UNIT, for ***narco*** Mark-12,
T-12MHP-12 or T-24MP-12, Top Front and Left Side.

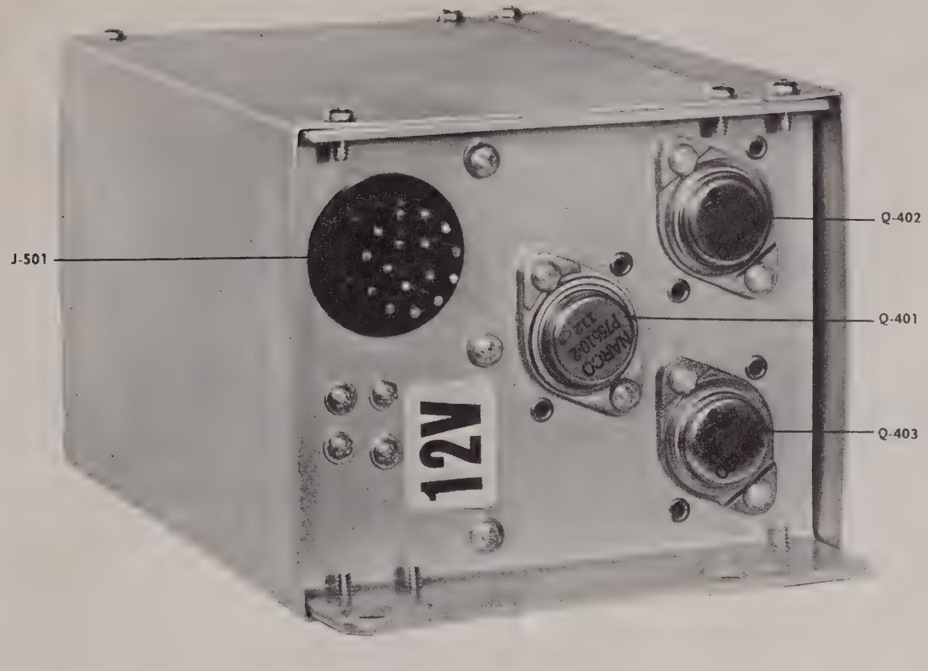

J-501
Q-402
Q-401
Q-403
12V

Photo H.
MODULATOR-POWER UNIT, for *narco* Mark-12,
T-12MP-12 or T-24MP-12, Rear View, In Case,

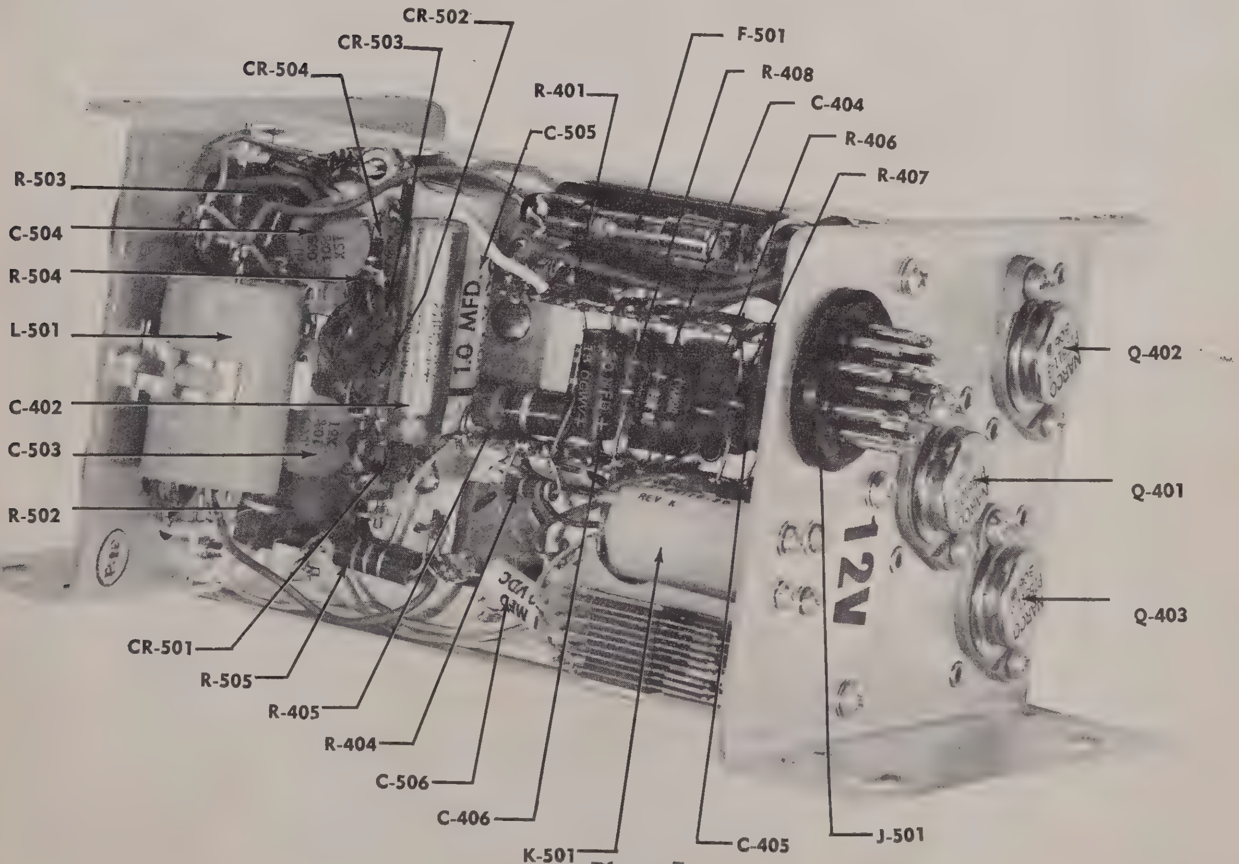

CR-502
CR-503
CR-504
R-401
C-505
F-501
R-408
C-404
R-406
R-407
R-503
C-504
R-504
L-501
C-402
C-503
R-502
1.0 MFD
12V
Q-402
Q-401
Q-403
CR-501
R-505
R-405
R-404
C-506
C-406
K-501
C-405
J-501

Photo I.
MODULATOR-POWER UNIT, for *narco* Mark-12,
T-12MP-12 or T-24MP-12, Bottom Rear and Right Side.

SECTION 7
REPLACEMENT PARTS

7-A. INTRODUCTION.

This list of Replacement Parts contains the items that may be considered replaceable in the field. They should preferably be ordered by Symbol No., Part No., and Description.

The Replacement Parts are listed by their Symbol letter and number, alphabetically then numerically. Some items without a Symbol No., are listed numerically by Part Number in a "Miscellaneous" List following the listings by Symbol numbers. A few items without a Symbol No. may be listed with associated parts such as connectors.

The "Function or Application" column is intended to separate the description of the item from its purpose in the equipment. It may also be found useful when working with the Illustrations and Schematics.

7-B. LIST OF PARTS.

SYMBOL	*narco* PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS	
C-101	21201-220	Ceramic Tubular, 500V, 22 micromicrofarads, ±10%	
C-102	21291-15	Ceramic Disc, 500V, .002 microfarads, ±10%	
C-103	21298-1	Feed-Thru, 500V, .001 microfarad, +100% –0%	
C-104	22019-2	Variable Plunger, 500V, 1.5 –12.5 micromicrofarads	
C-105	21298-1	Same as C-103	COM RCVR RF Input
C-106	21291-21	Ceramic Disc., 1000V., .001 microfarad, ±20%	
C-107	21384-750	Ceramic Tubular, 500V, 75 micromicrofarads, ±5%	
C-108	24516-229	Ceramic Disc., 500V, 2.2 micromicrofarads, ±0.25	
C-109	22019-1	Variable Plunger, 500V, 0.5 —4.5 micromicrofarads	
C-110	21291-21	Same as C-106	COM RCVR RF Output
C-111	24509-338	Ceramic, 500V., .33 micromicrofarads, ±5%	
C-112	22019-2	Same as C-104	
C-113	24502-109	Ceramic, 500V., 1.0 micromicrofarads, ±5%	COM RCVR First Mixer Input
C-114	21291-21	Same as C-106	
C-115	21291-4	Ceramic Disc, 500V, .003 microfarad, ±80% –20%	
C-116	24516-689	Ceramic Disc, 500V., 6.8 micromicrofarads, ±0.5 micromicrofarads	
C-117	22019-1	Same as C-109	COM RCVR First Mixer Output
C-118	22019-1	Same as C-109	COM RCVR HF IF
C-119	21291-9	Ceramic Disc, 500V., .003 microfarad, ±10%	
C-120	21201-220	Same as C-101	
C-121	24516-229	Same as C-108	
C-122	22019-1	Same as C-109	COM RCVR Second Mixer Input
C-123	21291-21	Same as C-106	
C-124	23085-71	Mylar, 100V., .047 microfarad, ±10%	
C-125	23085-171	Mylar, 200V., .047 microfarad, ±10%	
C-126	23085-71	Same as C-124	
C-127	23085-171	Same as C-125	
C-128	23085-71	Same as C-124	
C-129	23085-171	Same as C-125	
C-130	21291-11	Ceramic Disc, 500V., 200 micromicrofarads, ±10%	
C-131	21291-11	Same as C-130	
C-132	23085-75	Mylar, 100V, 0.1 microfarad, ±10%	
C-133	23085-71	Same as C-124	
C-134	21298-1	Same as C-103	
C-135	21291-6	Ceramic Disc, 500V., 0.01 microfarad, GMV	
C-136	24049-180	Dipped Mica, 500V., 18 micromicrofarads, ±5%	
C-137	24049-180	Dipped Mica, 500V., 12 micromicrofarads, ±1.0 micromicrofarads	
C-138	24049-750	Dipped Mica, 500 V., 75 micromicrofarads, ±5%	
C-139	23085-113	Mylar, 200V., .01 microfarad, ±20%	
C-140	21291-21	Same as C-106	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		C, CAPACITORS (Continued)	
C-141	21291-21	Same as C-106	
C-142	21291-21	Same as C-106	
C-143	21291-21	Same as C-106	
C-144	21298-1	Same as C-103	
C-145	21291-21	Same as C-106	
C-146	21291-21	Same as C-106	
C-147	21291-21	Same as C-106	
C-148	24516-150	Ceramic Disc, 15 micromicrofarads, ±10%	
C-149	21291-21	Same as C-106	
C-150	21298-1	Same as C-103	
C-151	21291-6	Same as C-135	
C-152	21291-5	Ceramic Disc, 50 V., .01 mf, +80% –30%	
C-153	21291-5	Same as C-152	
C-154	21291-21	Same as C-106	
C-155	21291-21	Same as C-106	
C-156	21291-21	Same as C-106	
C-157	21291-21	Same as C-106	
C-158	24516-339	Ceramic Disc, 500V., 3.3 micromicrofarads, ±10%	
C-159	23085-113	Same as C-139	
C-201		Not Used	
C-202	21291-21	Same as C-106	
C-203	21384-750	Same as C-107	
C-204	22019-1	Same as C-109	XMTR PA Output
C-205	21201-229	Ceramic Tubular, 500V, 2.2 micromicrofarads, 0.25 micromicrofarads	
C-206	21298-1	Same as C-103	
C-207	21291-21	Same as C-106	
C-208	21291-21	Same as C-106	
C-209	21298-1	Same as C-103	
C-210	21383-750	Ceramic Tub., 500V., 75 micromicrofarads, ±5%	
C-211	21201-150	Ceramic Tub., 500V., 15 mmf, ±10%	
C-212	21298-1	Same as C-103	
C-213	22019-1	Same as C-109	XMTR Buffer Output
C-214	21291-21	Same as C-106	
C-215	21291-21	Same as C-106	
C-216	21291-21	Same as C-106	
C-217	21383-750	Same as C-210	
C-218	21201-270	Ceramic Tub., 500V., 27 mmf, ±10%	
C-219	21298-1	Same as C-103	
C-220	21298-1	Same as C-103	
C-221	22019-1	Same as C-109	XMTR RF Amp. Output
C-222	21201-150	Same as C-211	
C-223	21291-21	Same as C-106	
C-224	21291-21	Same as C-106	
C-225	21201-479	Ceramic Tub., 500 V., 4.7 mmf, ±0.5 micromicrofarads	
C-226	21291-14	Ceramic Disc, 500V., 100 mmf, ±10%	
C-227	21298-1	Same as C-103	
C-228	22029-1	Split Stator Glass, 500V., 0.5 to 2.5 micromicrofarads	XMTR Mixer
C-229	21291-14	Same as C-226	
C-230	21291-21	Same as C-106	
C-231	21291-21	Same as C-106	
C-232	21298-1	Same as C-103	
C-233	24516-229	Same as C-108	
C-234	24516-229	Same as C-108	
C-235	21298-1	Same as C-103	

C, CAPACITORS, (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
C-236	21291-21	Same as C-106	
C-237	22019-1	Same as C-109	COM TCVR HFO/Doubler Output
C-238	24049-330	Dipped Mica, 500V., 33 micromicrofarads, ±5%	
C-239	24049-750	Same as C-138	
C-240	21201-759	Ceramic Tub., 500V., 7.5 micromicrofarads, ±0.5 micromicro-farad	
C-241	22019-1	Same as C-109	COM TCVR HFO/Doubler Input
C-242	24049-120	Same as C-137	
C-243	24049-750	Same as C-138	
C-244	21291-6	Same as C-135	
C-245	24049-220	Dipped Mica, 500V., 22 micromicrofarads, ±5%	
C-246	21291-21	Same as C-106	
C-247	21291-21	Same as C-106	
C-248	21298-1	Same as C-103	
C-249	21298-1	Same as C-103	
C-250	21291-19	Ceramic Disc, 500V., 1K micromicrofarad, ±10%	
C-251	21291-21	Same as C-106	
C-252	21291-21	Same as C-106	
C-253	21201-100	Ceramic Tub., 500 V., 10 micromicrofarads, ±1.0 micromicrofarads	
C-254	21291-21	Same as C-106	
C-255	21291-21	Same as C-106	
C-256	21291-21	Same as C-106	
C-257	21298-1	Same as C-103	
C-258	21291-21	Same as C-106	
C-259		Not Used	
C-260	21291-21	Same as C-106	
C-261	21291-6	Same as C-135	
C-262	21298-1	Same as C-103	
C-263	21291-21	Same as C-106	
C-264	24516-229	Same as C-108	
C-265	24516-229	Same as C-108	
C-266	21291-21	Same as C-106	
C-267	21291-21	Same as C-106	
C-268	21298-1	Same as C-103	
C-301	21201-100	Same as C-253	
C-302	21291-21	Same as C-106	
C-303	21201-100	Same as C-253	
C-304	21291-21	Same as C-106	
C-305	24516-689	Same as C-116	
C-306	22019-1	Same as C-109	NAV RCVR RF Output
C-307	24509-688	Ceramic, 500V., .68 micromicrofarads, ±5%	
C-308	22019-1	Same as C-109	NAV RCVR First Mixer Input
C-309	24516-689	Same as C-116	
C-310	24509-828	Ceramic, 500V., .82 micromicrofarads, ±5%	
C-311	21219-18	Ceramic Disc, 500V., 330 micromicrofarads, ±10%	
C-312	21291-4	Same as C-115	
C-313	21291-21	Same as C-106	
C-314	22019-1	Same as C-109	NAV RCVR First Mixer Output
C-315	21201-229	Same as C-205	
C-316	21291-6	Same as C-135	
C-317	23085-113	Same as C-139	
C-318	22001-312	Ceramic Trimmer, 350V., 3-12 mmf, NPO	NAV Second Mixer Input
C-319	21282-2	Ceramic Tub., 500V., 7.5 micromicrofarads, ±0.5%	
C-320	23085-71	Same as C-124	

C, CAPACITORS (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
C-321	21291-4	Same as C-115	
C-322	21207-120	Ceramic Tub., 12 micromicrofarads, ±10%, N-750	
C-323	21207-120	Same as C-322	
C-324	23085-71	Same as C-124	
C-325	21207-120	Same as C-322	
C-326	21291-4	Same as C-115	
C-327	23085-79	Mylar, 100V., .22 microfarad, ±10%	
C-328	21207-120	Same as C-322	
C-329	21291-14	Same as C-226	
C-330	21291-14	Same as C-226	
C-331	23085-79	Same as C-327	
C-332	23085-79	Same as C-327	
C-333	24049-150	Dipped Mica, 500 V., 15 micromicrofarads, ±1.0 micromicrofarad	
C-334	24049-750	Same as C-327	
C-335	22019-1	Same as C-109	NAV RCVR HFO Output
C-336	21291-21	Same as C-106	
C-337	21298-1	Same as C-103	
C-338	21298-1	Same as C-103	
C-339	21291-6	Same as C-135	
C-340	21299-470	Ceramic Tub., 500V., 47 micromicrofarads, ±10%	
C-341	24049-431	Dipped Mica, 500V., 15 micromicrofarads, ±1.0 micromicrofarad	
C-342	24045-122	Dipped Mica, 500V., 1200 micromicrofarads	
C-343	21206-330	Ceramic Tub., 500V., 33 mf, ±10%	
C-344	24517-1	Feed Thru, 500V., 100 micromicrofarads, ±10%	
C-345	22001-312	Same as C-318	
C-346	21201-330	Ceramic Tub., 500V., 33 micromicrofarads, ±10%	
C-347	21291-21	Same as C-106	
C-348	21291-21	Same as C-106	
C-349	21291-21	Same as C-106	
C-350	21298-1	Same as C-103	
C-351	21298-1	Same as C-103	
C-352	21291-21	Same as C-106	
C-353	21298-1	Same as C-103	
C-354	21291-21	Same as C-106	
C-355	21291-21	Same as C-106	
C-356	21291-5	Same as C-152	
C-357	21291-21	Same as C-106	
C-358	21291-21	Same as C-106	
C-359	21282-2	Same as C-319	
C-360	21291-21	Same as C-106	
C-361	21291-21	Same as C-106	
C-362	24516-150	Same as C-148	
C-401	21552-16	Electrolytic, 3V., 150 microfarads, +150% –10%	
C-402	21552-17	Electrolytic, 15V., 500 microfarads, Min. Tol.	
C-403	23085-113	Same as C-139	
C-404	21552-3	Electrolytic, 35V., 20 mf, +150% -10%	
C-405	21291-22	Ceramic Disc, 500V., .005 mf, ±10%	
C-406	21552-18	Electrolytic, 15 forward, 5 reverse, 30 mfd, +150% –10%	
C-501	23085-25	Mylar, 0.1 mfd, 100V., ±20%	
C-502	21525-23	Electrolytic, 400V., –50 mf, 200V. –100 mf, 200V. –20 mf	
C-503	21291-23	Ceramic Disc, 500V., .004 mf, ±10%	24 V. Operation
C-503	21291-22	Same as C-405	12 V. Operation
C-504	21291-22	Same as C-503	12 V. Operation
C-504	21291-23	Same as C-503	24 V. Operation
C-505	23085-87	Mylar, 100V., 1.0 mf, ±10%	
C-506	21525-25	Electrolytic, 35V., 500 mf	

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
		CR, DIODES	
CR-101	75013-5	Diode, Silicon, 1N459	COM TCVR ANT Switching
CR-102	75019-1	Diode, Silicon, 1N914	COM RCVR
CR-103	75013-4	Diode, Silicon, 1N457	COM RCVR
CR-301	75019-1	Same as CR-102	NAV RCVR
CR-302	75013-4	Same as CR-103	NAV RCVR
CR-303	75013-4	Same as CR-103	NAV RCVR
CR-501	75204-5	Diode, Silicon, 500 PIV	MOD-PWR Unit
CR-502	75204-5	Same as CR-501	MOD-PWR Unit
CR-503	75204-5	Same as CR-501	MOD-PWR Unit
CR-504	75204-5	Same as CR-501	MOD-PWR Unit
CR-505	75204-5	Same as CR-501	MOD-PWR Unit
CR-506	75204-5	Same as CR-501	MOD-PWR Unit
		F, FUSES	
F-501	66504-12	Fuse, 10A, Slow-Acting Type	12V. MOD-PWR Unit
F-501	66504-10	Fuse, 6¼A, Slow-Acting Type	24V. MOD-PWR Unit
		I, LAMPS	
I-101		Lamp #53 Red	Panel Illumination
I-102		Lamp, Same as I-101	Panel Illumination
		J, JACKS (CONNECTORS)	
J-101	41110-2	Connector, Chassis, Female	Com. Ant., Panel Unit
J-301	41143-1	Connector, Chassis, Female	Nav. Ant., Panel Unit
J-501	41181-4	Connector, 16 Pin	Power, MP Unit
		K, RELAYS	
K-501	65126-20	Relay, 5 Form C Contacts	T-R Transfer MOD-PWR Unit
		L, INDUCTORS	
L-101	11135-9	Choke	RF Antenna Filter
L-102	11273-26	Coil, Ant. Com. Rec.	
L-103	61378-101	Step Inductor	
L-104	11412-123	Coil, RF Plate, Com.	
L-105	61378-101	Same as L-103	
L-106	11412-129	Coil, Mixer, Comm.	
L-107	61378-101	Same as L-103	
L-108	61406-1	Step Inductor	HF IF COM
L-109	61406-1	Same as L-108	
L-110	61406-1	Same as L-108	
L-111	11138-22	Choke, RF, 18 microhenries, ±10%	
L-112	11135-9	Same as L-101	
L-113	11138-19	Choke, RF, 15 microhenries, ±10%, Insulated	
L-114	11138-9	Choke, RF, 2.2 microhenries	
L-201	61378-101	Same as L-103	
L-202	11627-1	Coil, Final Tank	
L-203	11138-9	Same as L-114	
L-204	11138-8	Choke, RF, 1.5 microhenry, ±20%	
L-205	61378-101	Same as L-103	

L, INDUCTORS (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
L-206	11138-9	Same as L-203	
L-207	11412-133	Coil, Second Buffer	
L-208	11138-8	Same as L-204	
L-209	61378-101	Same as L-103	
L-210	11138-11	Choke, RF, 3.3 microhenries, ±10%	
L-211	11412-134	Coil, First Buffer	
L-212	61378-101	Same as L-103	
L-213	11138-4	Choke, RF, 0.33 microhenry, ±20%	
L-214	11412-135	Coil, Mixer	
L-215	11412-132	Coil, Doubler	
L-216	61393-101	Step Inductor Doubler	
L-217	11138-5	Choke, RF, 0.47 microhenry, ±10%	
L-218	11412-112	Coil, HFO	
L-219	61393-101	Same as L-216	
L-220	11138-22	Same as L-111	
L-221	11138-5	Same as L-217	
L-222	11138-5	Same as L-217	
L-223	11138-5	Same as L-217	
L-224	11138-5	Same as L-217	
L-225		Not Used	
L-226		Not Used	
L-227	11138-4	Same as L-213	
L-301	11273-22	Coil, RF	
L-302	61386-1	Step Inductor	
L-303	11138-27	Choke, RF, 0.09 microhenry, ±10%	
L-304	61386-1	Same as L-302	
L-305	11138-27	Same as L-303	
L-306	61386-1	Same as L-302	
L-307	61407-1	Step Inductor, HF IF	
L-308	61407-1	Same as L-307	
L-309	11412-131	Coil, HFO	
L-310	61386-1	Same as L-302	
L-311	11138-2	Choke, RF, 0.15 microhenry, ±20%	
L-312	11359-20	Choke, RF, 39 microhenries, ±10%	
L-313	11138-28	Choke, RF, 0.49 microhenries, ±5%	
L-314	11273-21	Coil, LFO	
L-315	61384-1	Step Inductor, LFO	
L-316	11138-5	Same as L-217	
L-317	11135-9	Same as L-101	
L-401	11814-2	Inductor, Filter	
L-501	11176-3	Choke, 50 microhenries	

P, PLUGS (Connectors)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
P-101	41181-3	Connector, 16 Pin Male	Power Circuits, Panel Unit Cable Assy.
	41182-2	Cap, Connector, for P-102 and P-501	Power Circuits, Panel Unit Cable Assy.
P-102	41271-1	Connecter, 16 Pin Female	Panel to MP Unit Cable
P-301	41117-1	Connector, 6 Pin Female	Omni Circuits, Panel Unit Cable Assy.
	41130-1	Connector, Male	COM Ant.
	41237-1	Connector, Male	NAV Ant. Cable
	41237-2	Ferrule, for 41237-1	NAV Ant. Cable
P-501	41271-1	Same as P-102	Same as P-102

Q, TRANSISTORS

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
Q-401	75510-2	Transistor, Driver	
Q-402	75510-4	Transistor, Audio Output	12 V. MOD-PWR Unit
Q-402	75511-3	Transistor, Audio Output	24 V. MOD-PWR.Unit
Q-403	75510-4	Same as Q-402	12 V. MOD-PWR Unit
Q-403	75511-3	Same as Q-402	24 V. MOD-PWR.Unit
Q-501	75504-1	Transistor, DC Power, 2N441	12 V. MOD-PWR Unit
O-501	75505-3	Transistor, DC Power, 2N174	24 V. MOD-PWR.Unit
Q-502	75504-1	Same as Q-501	12 V. MOD-PWR Unit
Q-502	75505-3	Same as Q-501	24 V. MOD-PWR.Unit

R, RESISTORS

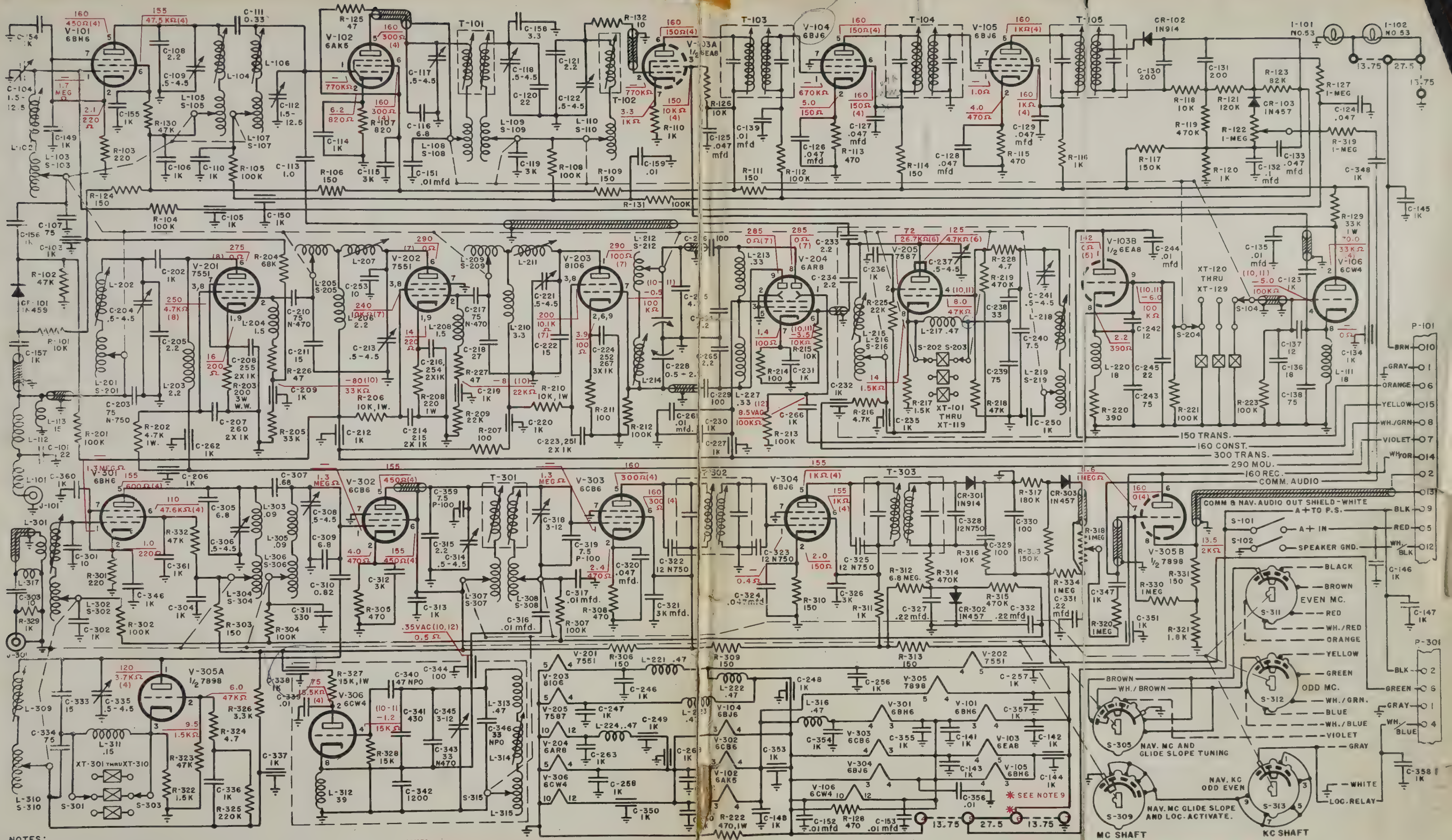
SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-101	31141-103	Carbon, ½ W, 10K ohms, ±10%	
R-102	31141-473	Carbon, ½ W, 47K ohms, ±10%	
R-103	31141-221	Carbon, ½ W, 220 ohms, ±10%	
R-104	31141-104	Carbon, ½ W, 100K ohms, ±10%	
R-105	31141-104	Same as R-104	
R-106	31141-151	Carbon, ½ W, 150 ohms, ±10%	
R-107	31141-821	Carbon, ½ W, 820 ohms, ±10%	
R-108	31141-104	Same as R-104	
R-109	31141-151	Same as R-106	
R-110	31141-102	Carbon, ½ W, 1K ohms, ±10%	
R-111	31141-151	Same as R-106	
R-112	31141-104	Same as R-104	
R-113	31141-471	Carbon, ½ W, 1.2K ohms, ±10%	
R-114	31141-151	Same as R-106	
R-115	31141-471	Same as R-107	
R-116	31141-102	Same as R-110	
R-117	31141-154	Carbon, ½ W, 150K ohms, ±10%	
R-118	31141-103	Same as R-101	
R-119	31141-474	Carbon, ½ W, 470K ohms, ±10%	
R-120	31141-102	Same as R-110	
R-121	31141-124	Carbon, ½ W, 120K ohms, ±10%	
R-122	32040-1	Potentiometer, ½ W, 1 Meg. ohms, ±5%	Volume Control
R-123	31141-823	Carbon, ½ W, 82K ohms, ±10%	
R-124	31141-151	Same as R-106	
R-125	31141-470	Carbon, ½ W, 47 ohms, ±10%	
R-126	31141-103	Same as R-101	
R-127	31141-105	Carbon, ½ W, 1 Megohm, ±10%	
R-128	31141-471	Same as R-305	
R-129	31135-333	Carbon, 1 W, 33 K ohms, ±10%	
R-130	31141-473	Same as R-102	
R-131	31141-104	Same as R-104	
R-132	31141-100	Carbon, ½ W, 10 ohms, ±10%	
R-133	31141-222	Carbon, ½ W, 2.2K ohms, ±10%	

R, RESISTORS (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-201	31141-104	Same as R-104	
R-202	31135-472	Carbon, 1 W, 4.7K ohms, ±10%	
R-203	31161-8	Wire-wound, 3 W, 200 ohms, ±5%	
R-204	31141-683	Carbon, ½ W, 68K ohms, ±10%	
R-205	31141-333	Carbon, ½ W, 33K ohms, ±10%	
R-206	31135-103	Carbon, 1 W, 10K ohms, ±10%	
R-207	31141-101	Carbon, ½ W, 100 ohms, ± 10%	
R-208	31135-221	Carbon, 1 W, 220 ohms, ±10%	
R-209	31141-223	Carbon, ½ W, 22K ohms, ±10%	
R-210	31135-103	Same as R-206	
R-211	31141-101	Same as R-207	
R-212	31141-104	Same as R-104	
R-213	31141-104	Same as R-104	
R-214	31141-101	Same as R-207	
R-215	31141-103	Same as R-101	
R-216	31141-472	Carbon, ½W, 4.7K ohms, ±10%	
R-217	31141-152	Carbon, ½ W, 1.5K ohms, ±10%	
R-218	31141-473	Same as R-102	
R-219	31141-474	Same as R-119	
R-220	31141-391	Carbon, ½ W, 390 ohms, ±10%	
R-221	31141-104	Same as R-104	
R-222	31135-471	Carbon, 1 W, 470 ohms, ±10%	
R-223	31141-104	Same as R-104	
R-224		Note Used	
R-225	31141-223	Same as R-209	
R-226	31141-470	Same as R-125	
R-227	31141-470	Same as R-125	
R-228	31141-479	Carbon, ½ W, 4.7 ohms, ±10%	
R-301	31141-221	Same as R-103	
R-302	31141-104	Same as R-104	
R-303	31141-151	Same as R-106	
R-304	31141-104	Same as R-104	
R-305	31141-471	Carbon, ½ W, 470 ohms, ±10%	
R-306	31141-151	Same as R-106	
R-307	31141-104	Same as R-104	
R-308	31141-471	Same as R-305	
R-309	31141-151	Same as R-106	
R-310	31141-141	Same as R-106	
R-311	31141-102	Same as R-110	
R-312	31141-685	Carbon, ½ W, 6.8 Megohms, ±10%	
R-313	31141-151	Same as R-106	
R-314	31141-474	Same as R-119	
R-315	31141-474	Same as R-119	
R-316	31141-103	Same as R-101	
R-317	31141-184	Carbon, ½ W, 180K ohms, ±10%	
R-318	32040-2	Potentiometer, ½ W, 1 Meg., ±5%	Volume Control
R-319	31141-105	Same as R-127	
R-320	31141-105	Same as R-127	
R-321	31141-182	Carbon, ½ W, 1.8K ohms, ±10%	
R-322	31141-152	Same as R-217	
R-323	31141-473	Same as R-102	
R-324	31141-479	Same as R-228	
R-325	31141-224	Carbon, ½ W, 220K ohms, ±10%	
R-326	31141-332	Carbon, ½ W, 3.3K ohms, ±10%	
R-327	31135-153	Carbon, 1 W, 15K ohms, ±10%	
R-328	31141-153	Carbon, ½ W, 15K ohms, ±10%	
R-329	31141-102	Same as R-110	
R-330	31141-105	Same as R-127	
R-331	31141-151	Same as R-106	
R-332	31141-473	Same as R-102	
R-333	31141-154	Same as R-117	
R-334	31141-105	Same as R-127	

R, RESISTORS (Continued)

SYMBOL	NARCO PART NO.	DESCRIPTION	FUNCTION OR APPLICATION
R-201	31141-104	Same as R-104	
R-202	31135-472	Carbon, 1 W, 4.7K ohms, ±10%	
R-203	31161-8	Wire-wound, 3 W, 200 ohms, ±5%	
R-204	31141-683	Carbon, ½ W, 68K ohms, ±10%	
R-205	31141-333	Carbon, ½ W, 33K ohms, ±10%	
R-206	31135-103	Carbon, 1 W, 10K ohms, ±10%	
R-207	31141-101	Carbon, ½ W, 100 ohms, ± 10%	
R-208	31135-221	Carbon, 1 W, 220 ohms, ±10%	
R-209	31141-223	Carbon, ½ W, 22K ohms, ±10%	
R-210	31135-103	Same as R-206	
R-211	31141-101	Same as R-207	
R-212	31141-104	Same as R-104	
R-213	31141-104	Same as R-104	
R-214	31141-101	Same as R-207	
R-215	31141-103	Same as R-101	
R-216	31141-472	Carbon, ½W, 4.7K ohms, ±10%	
R-217	31141-152	Carbon, ½ W, 1.5K ohms, ±10%	
R-218	31141-473	Same as R-102	
R-219	31141-474	Same as R-119	
R-220	31141-391	Carbon, ½ W, 390 ohms, ±10%	
R-221	31141-104	Same as R-104	
R-222	31135-471	Carbon, 1 W, 470 ohms, ±10%	
R-223	31141-104	Same as R-104	
R-224		Note Used	
R-225	31141-223	Same as R-209	
R-226	31141-470	Same as R-125	
R-227	31141-470	Same as R-125	
R-228	31141-479	Carbon, ½ W, 4.7 ohms, ±10%	
R-301	31141-221	Same as R-103	
R-302	31141-104	Same as R-104	
R-303	31141-151	Same as R-106	
R-304	31141-104	Same as R-104	
R-305	31141-471	Carbon, ½ W, 470 ohms, ±10%	
R-306	31141-151	Same as R-106	
R-307	31141-104	Same as R-104	
R-308	31141-471	Same as R-305	
R-309	31141-151	Same as R-106	
R-310	31141-141	Same as R-106	
R-311	31141-102	Same as R-110	
R-312	31141-685	Carbon, ½ W, 6.8 Megohms, ±10%	
R-313	31141-151	Same as R-106	
R-314	31141-474	Same as R-119	
R-315	31141-474	Same as R-119	
R-316	31141-103	Same as R-101	
R-317	31141-184	Carbon, ½ W, 180K ohms, ±10%	
R-318	32040-2	Potentiometer, ½ W, 1 Meg., ±5%	Volume Control
R-319	31141-105	Same as R-127	
R-320	31141-105	Same as R-127	
R-321	31141-182	Carbon, ½ W, 1.8K ohms, ±10%	
R-322	31141-152	Same as R-217	
R-323	31141-473	Same as R-102	
R-324	31141-479	Same as R-228	
R-325	31141-224	Carbon, ½ W, 220K ohms, ±10%	
R-326	31141-332	Carbon, ½ W, 3.3K ohms, ±10%	
R-327	31135-153	Carbon, 1 W, 15K ohms, ±10%	
R-328	31141-153	Carbon, ½ W, 15K ohms, ±10%	
R-329	31141-102	Same as R-110	
R-330	31141-105	Same as R-127	
R-331	31141-151	Same as R-106	
R-332	31141-473	Same as R-102	
R-333	31141-154	Same as R-117	
R-334	31141-105	Same as R-127	


V-101 6BH6
V-102 6AK5
T-101
V-103A 1/2 6EA8
T-102
T-103
V-104 6BJ6
T-104
V-105 6BJ6
T-105
CR-102 IN914
I-101 NO.53
I-102 NO.53
13.75
27.5
V-201 7551
V-202 7551
V-203 8106
V-204 6AR8
V-205 7587
V-103B 1/2 6EA8
V-106 6CW4
XT-120 THRU XT-129
XT-101 THRU XT-119
P-101
BRN
GRAY
ORANGE
YELLOW
WH./GRN
VIOLET
WH./YOR
150 TRANS.
160 CONST.
300 TRANS.
290 MOU.
160 REC.
COMM. AUDIO
V-301 6BH6
V-302 6CB6
T-301
V-303 6CB6
T-302
V-304 6BJ6
T-303
CR-301 IN914
CR-303 IN457
CR-302 IN457
V-305B 1/2 7898
COMM & NAV. AUDIO OUT SHIELD-WHITE
A+TO P.S.
S-101
A+ IN
S-102
SPEAKER GND.
BLK
RED
WH./BLK
EVEN MC.
S-311
ODD MC.
S-312
NAV. MC AND GLIDE SLOPE TUNING
S-305
NAV. KC ODD EVEN
S-313
S-309
NAV. MC GLIDE SLOPE AND LOC. ACTIVATE.
MC SHAFT
KC SHAFT
LOC. RELAY
P-301
J-101
J-301
V-305A 1/2 7898
V-306 6CW4
XT-301 THRU XT-310
S-301
S-303
S-315
✻ SEE NOTE 9

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.

B.- ALL INDUCTORS ARE SHOWN IN MICRO-HENRIES UNLESS OTHERWISE NOTED.

C.- ALL RESISTORS ARE SHOWN IN ONE-HALF WATT UNLESS OTHERWISE NOTED.

D.- "K" DENOTES ONE THOUSAND. "M" DENOTES ONE MILLION.

NOTES:

1.- ALL RECEIVER VOLTAGES MEASURED WITH VOLUME CONTROLS FULL CW, NO SIGNAL INPUT AND 13.75 V DC APPLIED TO UNIT.

2.- ALL TRANSMITTER VOLTAGES MEASURED WITH TRANSMITTER KEYED AND 13.75 V DC APPLIED TO UNIT.

3.- ALL RESISTANCES MEASURED TO CHASSIS (GND.) UNLESS OTHERWISE NOTED.

4.- MEASURED TO TERMINAL 14 OF P-101.

5.- MEASURED TO TERMINAL 6 OF P-101.

6.- MEASURED TO TERMINAL 15 OF P-101.

7.- MEASURED TO TERMINAL 8 OF P-101.

8.- MEASURED TO TERMINAL 7 OF P-101.

9.- TERMINALS 4, 5, 6, AND 7 ARE LOCATED ON THE 8 TERMINAL TIE LUG STRIP MOUNTED BENEATH THE VOLUME CONTROLS. VIEWED FROM FRONT, TERMINALS ARE NUMBERED FROM RIGHT TO LEFT.

10.- VOLTAGES SHOWN ARE AVERAGE. VARIATIONS OF ± 20 %. CAN BE EXPECTED.

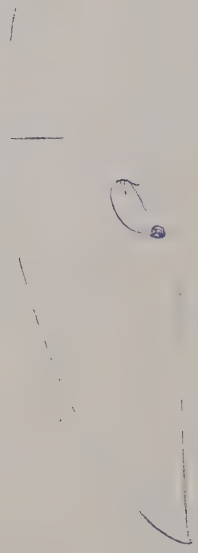
11.- MEASURED THRU A 1 MEG. OHM RESISTOR.

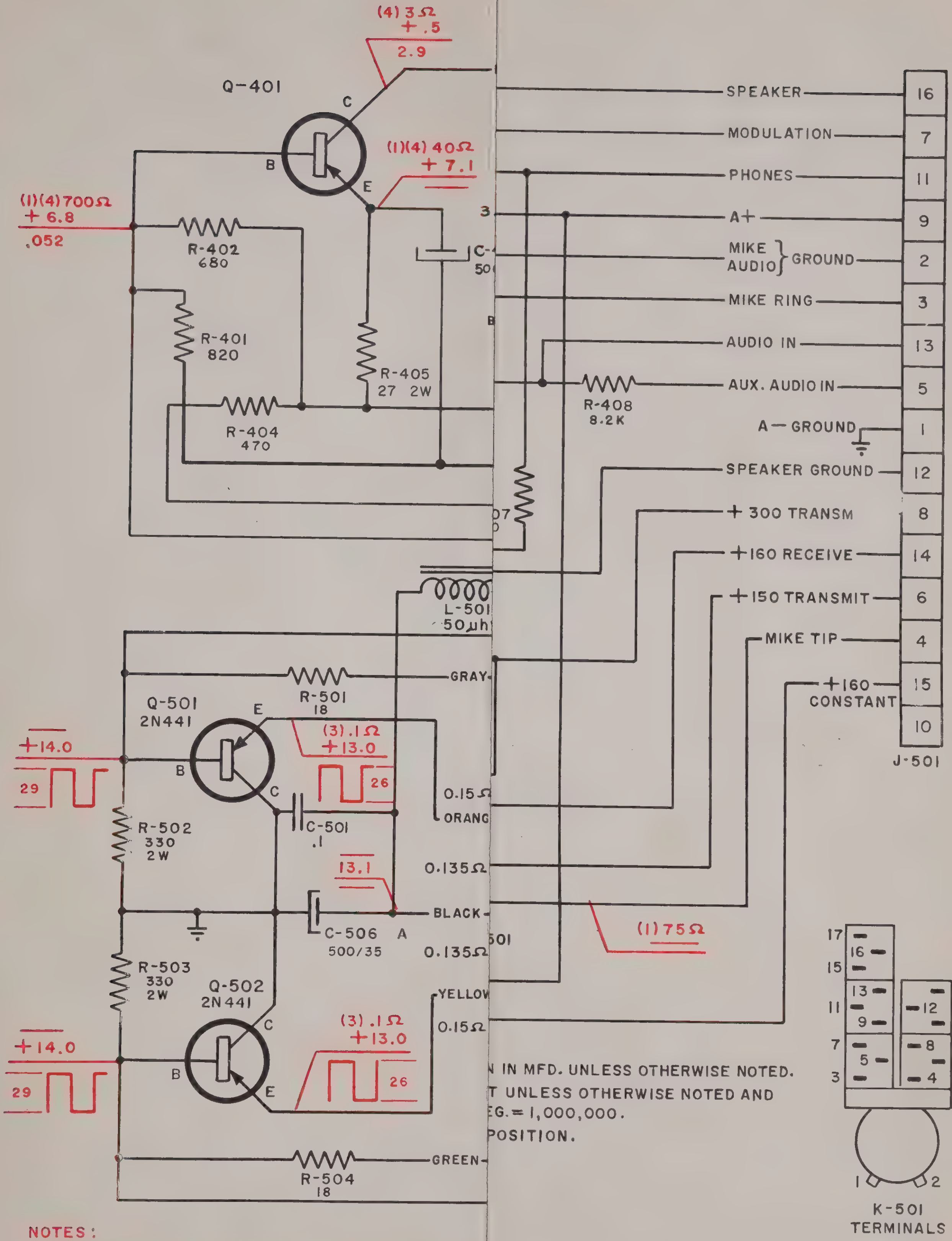
12.- MEASURED WITH A HIGH IMPEDANCE, LOW CAPACITY R.F. (10 MC) VOLTMETER.

13.- VOLTAGE SHOWN ABOVE LINE - EXAMPLE $\frac{\text{VOLTAGE}}{\text{RESISTANCE}}$

Ref. T-02177-K
2-15-63

Figure 6.
SCHEMATIC
narco MARK-12 PANEL UNIT



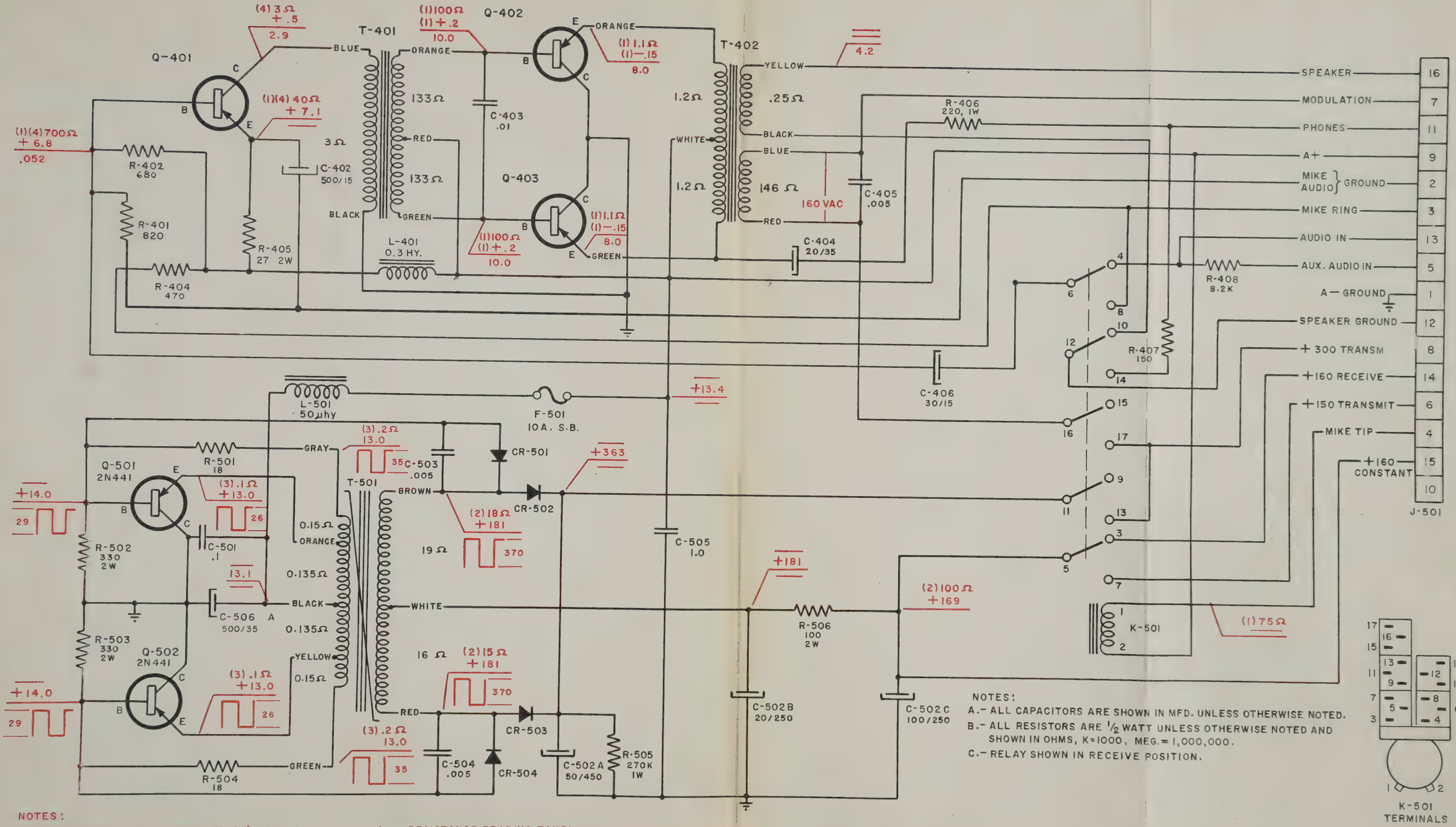

(4) 3Ω
+ .5
2.9
Q-401
C
B
E
(1)(4) 40Ω
+ 7.1
(1)(4) 700Ω
+ 6.8
.052
R-402
680
R-401
820
R-405
27 2W
R-404
470
C-
50
3
B
07
L-501
50µh
R-408
8.2K
SPEAKER
MODULATION
PHONES
A+
MIKE
AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A — GROUND
SPEAKER GROUND
+ 300 TRANSM
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160
CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
Q-501
2N441
GRAY
R-501
18
E
B
C
+14.0
29
(3) .1Ω
+13.0
26
0.15Ω
ORANG
R-502
330
2W
C-501
.1
13.1
0.135Ω
BLACK
C-506
500/35
A
0.135Ω
501
(1) 75Ω
R-503
330
2W
Q-502
2N441
YELLOW
0.15Ω
+14.0
29
(3) .1Ω
+13.0
26
B
C
E
GREEN
R-504
18
17
16
15
13
11
9
7
5
3
14
12
10
8
6
4
1
2
K-501
TERMINALS

N IN MFD. UNLESS OTHERWISE NOTED.
T UNLESS OTHERWISE NOTED AND
EG. = 1,000,000.
POSITION.

NOTES:
(1) - MEASURED WITH RESPECT TO A +, PIN-9.
(2) - MEASURED WITH RESPECT TO WHITE LEAD OF
(3) - MEASURED WITH RESPECT TO BLACK LEAD OF
(4) - MEASURED WITH Q-401 REMOVED.

Figure 7.
SCHEMATIC
narco **T12MP-12** MOD-PWR UNIT
for
narco MARK-12

Ref. T-02178-F
2-14-63


Q-401
(4) 3 Ω
+ .5
2.9
(1)(4) 40 Ω
+ 7.1
(1)(4) 700 Ω
+ 6.8
.052
T-401
BLUE
ORANGE
133 Ω
3 Ω
RED
133 Ω
BLACK
GREEN
(1) 100 Ω
(1) + .2
10.0
Q-402
E
ORANGE
B
C
(1) 1.1 Ω
(1) — .15
8.0
C-403
.01
Q-403
(1) 100 Ω
(1) + .2
10.0
(1) 1.1 Ω
(1) — .15
8.0
GREEN
R-402
680
R-401
820
R-405
27 2W
C-402
500/15
R-404
470
L-401
0.3 HY.
T-402
YELLOW
1.2 Ω
.25 Ω
WHITE
BLACK
BLUE
1.2 Ω
146 Ω
160 VAC
RED
4.2
R-406
220, 1W
C-405
.005
C-404
20/35
C-406
30/15
R-407
150
R-408
8.2K
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A— GROUND
SPEAKER GROUND
+ 300 TRANSM
+ 160 RECEIVE
+ 150 TRANSMIT
MIKE TIP
+ 160 CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
L-501
50 μhy
F-501
10A. S.B.
+ 13.4
Q-501
2N441
+ 14.0
29
R-501
18
GRAY
(3) .2 Ω
13.0
35
C-503
.005
CR-501
+ 363
(3) .1 Ω
+ 13.0
26
C-501
.1
T-501
BROWN
0.15 Ω
ORANGE
(2) 18 Ω
+ 181
CR-502
370
19 Ω
C-505
1.0
R-502
330
2W
13.1
0.135 Ω
C-506
500/35
A
BLACK
WHITE
0.135 Ω
+ 181
R-506
100
2W
(2) 100 Ω
+ 169
R-503
330
2W
Q-502
2N441
YELLOW
0.15 Ω
16 Ω
(2) 15 Ω
+ 181
370
(3) .1 Ω
+ 13.0
26
+ 14.0
29
RED
CR-503
(3) .2 Ω
13.0
35
GREEN
R-504
18
C-504
.005
CR-504
C-502A
50/450
R-505
270K
1W
C-502B
20/250
C-502C
100/250
K-501
(1) 75 Ω
K-501 TERMINALS

NOTES:
A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.
B.- ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.
C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES:
(1) - MEASURED WITH RESPECT TO A +, PIN-9.
(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.
(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.
(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READING TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS OF AUDIO OUT, WITH NORMAL 13.75 V. INTO POWER CABLE AT MARK-12. (AUDIO FREQUENCY 1000 CYCLES)

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE

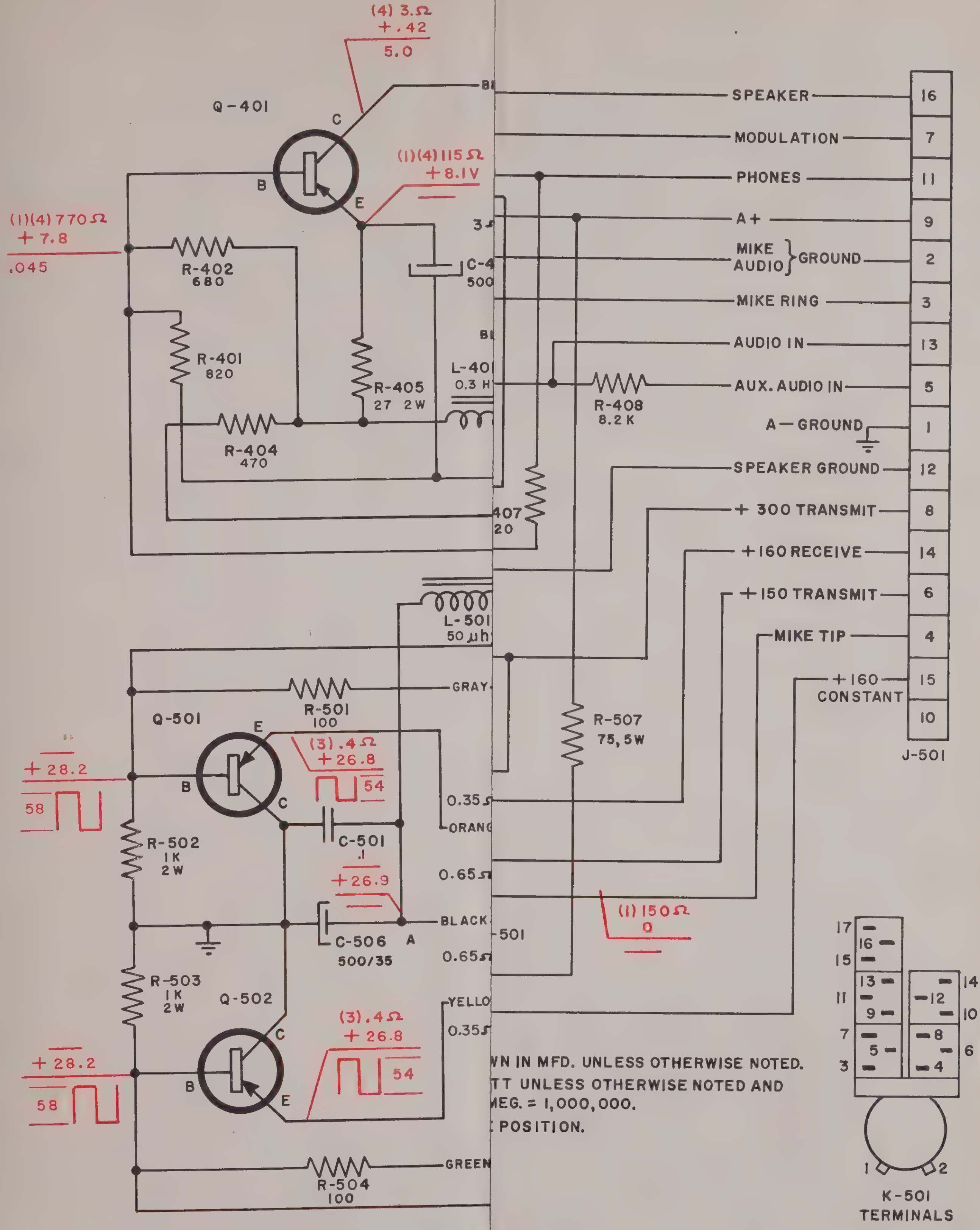
RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR WAVE SHAPE & P-P VOLTAGE

Ref. T-02178-F
2-14-63

Figure 7.
SCHEMATIC
narco **T12MP-12** MOD-PWR UNIT
for
narco MARK-12


(4) 3.Ω
+.42
5.0
Q-401
C
B
E
(1)(4) 115 Ω
+8.1V
(1)(4) 770 Ω
+7.8
.045
R-402
680
R-401
820
R-405
27 2W
R-404
470
C-4
500
3
L-40
0.3 H
407
20
L-501
50 µh
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO } GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
R-408
8.2 K
A—GROUND
SPEAKER GROUND
+ 300 TRANSMIT
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160 CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
GRAY
R-501
100
Q-501
E
(3) .4 Ω
+26.8
54
+28.2
58
B
C
R-502
1K
2W
C-501
.1
+26.9
0.35
ORANG
0.65
BLACK
-501
C-506
500/35
A
0.65
R-507
75, 5W
(1) 150 Ω
0
R-503
1K
2W
Q-502
C
(3) .4 Ω
+26.8
54
+28.2
58
B
E
YELLO
0.35
GREEN
R-504
100
WN IN MFD. UNLESS OTHERWISE NOTED.
TT UNLESS OTHERWISE NOTED AND
MEG. = 1,000,000.
POSITION.
17
16
15
13
11
9
7
5
3
14
12
10
8
6
4
1
2
K-501
TERMINALS

NOTES :-

(1) - MEASURED WITH RESPECT TO A +, PIN-9.

(2) - MEASURED WITH RESPECT TO WHITE LEAD OF

(3) - MEASURED WITH RESPECT TO BLACK LEAD O

(4) - MEASURED WITH Q-401 REMOVED.

Figure 8.
SCHEMATIC
narco **T24MP-12** MOD-PWR UNIT
for
narco MARK-12

Ref. T-02183
2-15-63

SUPPLEMENT 2

Place this sheet at the front of the original manual (MM3077-600) to indicate that the supplement is included in this maintenance manual.

MARK 12A

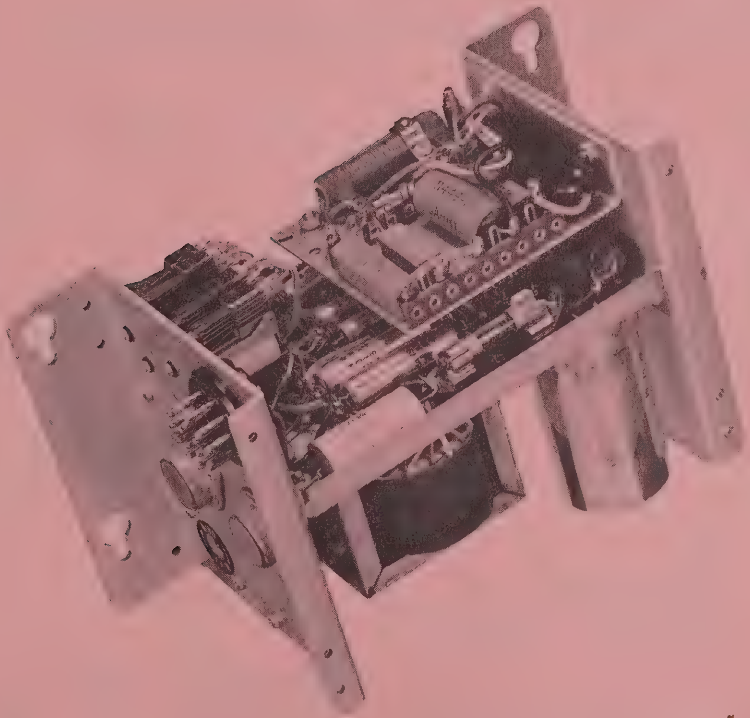
MODULATOR — POWER UNIT

T(12) or T(24)

MP-12A-1 and MP-12AH-1

14/28 VOLT

MAINTENANCE MANUAL



NARCO AVIONICS
DIVISION OF NARCO SCIENTIFIC INDUSTRIES
FORT WASHINGTON, PENNSYLVANIA, 19034 U.S.A.

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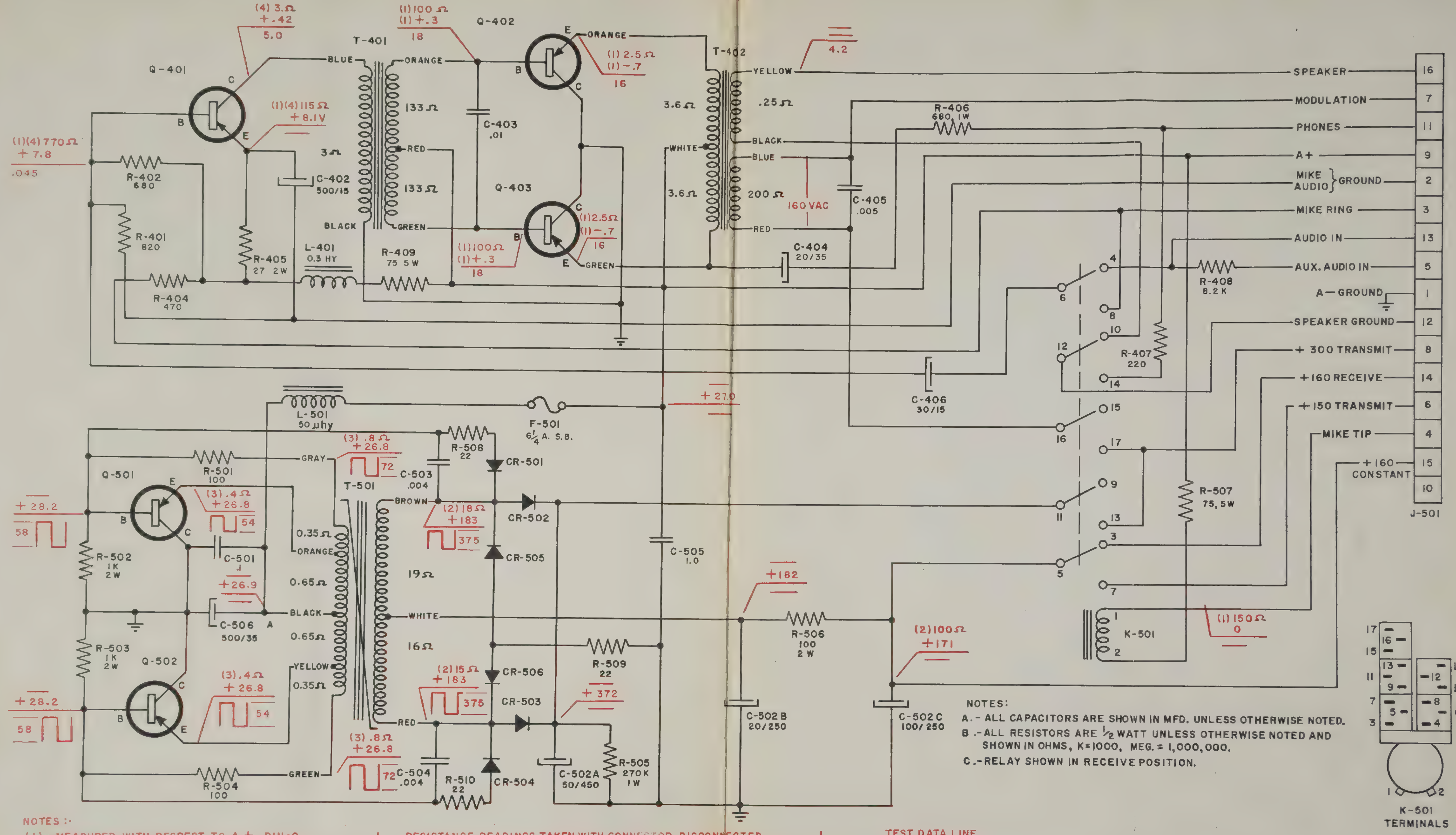
April, 1968


Q-401
Q-402
Q-403
Q-501
Q-502
T-401
T-402
T-501
L-401 0.3 HY
L-501 50 µhy
F-501 6¼ A. S.B.
R-401 820
R-402 680
R-404 470
R-405 27 2W
R-406 680 1W
R-407 220
R-408 8.2 K
R-409 75 5W
R-501 100
R-502 1K 2W
R-503 1K 2W
R-504 100
R-505 270K 1W
R-506 100 2W
R-507 75, 5W
R-508 22
R-509 22
R-510 22
C-402 500/15
C-403 .01
C-404 20/35
C-405 .005
C-406 30/15
C-501 .1
C-502A 50/450
C-502B 20/250
C-502C 100/250
C-503 .004
C-504 .004
C-505 1.0
C-506 500/35
CR-501
CR-502
CR-503
CR-504
CR-505
CR-506
K-501
J-501
BLUE
ORANGE
RED
GREEN
BLACK
YELLOW
WHITE
BROWN
GRAY
133Ω
3Ω
3.6Ω
.25Ω
200Ω
160 VAC
4.2
0.35Ω
0.65Ω
19Ω
16Ω
(4) 3.Ω
+.42
5.0
(1)100Ω
(1)+.3
18
(1) 2.5Ω
(1) −.7
16
(1)(4)115Ω
+8.1V
(1)(4)770Ω
+7.8
.045
+27.0
(3) .8Ω
+26.8
72
(3) .4Ω
54
+28.2
58
+26.9
(2) 18Ω
+183
375
(2) 15Ω
+372
+182
(2)100Ω
+171
(1) 150Ω
0
SPEAKER 16
MODULATION 7
PHONES 11
A+ 9
MIKE AUDIO GROUND 2
MIKE RING 3
AUDIO IN 13
AUX. AUDIO IN 5
A—GROUND 1
SPEAKER GROUND 12
+300 TRANSMIT 8
+160 RECEIVE 14
+150 TRANSMIT 6
MIKE TIP 4
+160 CONSTANT 15
10
K-501 TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

NOTES:-

(1) - MEASURED WITH RESPECT TO A +, PIN-9.
(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.
(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.
(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READINGS TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS OF AUDIO OUT (FREQUENCY 1000CYCLES), WITH NORMAL 27.5V. INTO POWER CABLE AT MARK-12.

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE

RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR

WAVE SHAPE & P-P VOLTAGE

Ref. T-02183
2-15-63

Figure 8.
SCHEMATIC
narco **T24MP-12** MOD-PWR UNIT
for
narco MARK-12

SUPPLEMENT 2

Place this sheet at the front of the original manual (MM3077-600) to indicate that the supplement is included in this maintenance manual.

MARK 12A

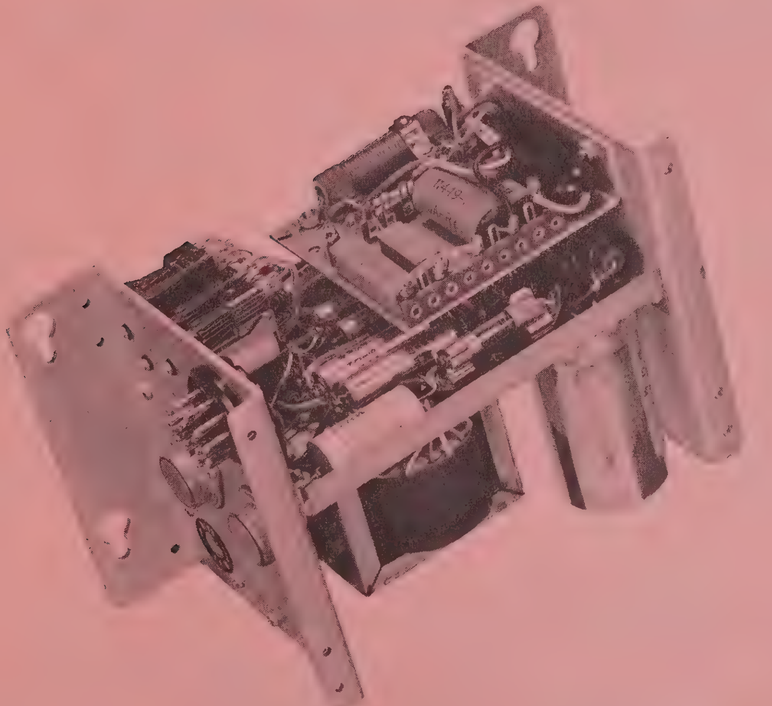
MODULATOR — POWER UNIT

T(12) or T(24)

MP-12A-1 and MP-12AH-1

14/28 VOLT

MAINTENANCE MANUAL



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DIVISION OF NARCO SCIENTIFIC INDUSTRIES
FORT WASHINGTON, PENNSYLVANIA, 19034 U.S.A.

Printed in U.S.A.

April, 1968

SUPPLEMENT 2
April, 1968

MARK 12A

MODULATOR — POWER UNIT

T(12) or T(24)

MP-12A-1 and MP-12AH-1

14/28 VOLT

For Use with Narco Avionics Mark 12A

Remove the front cover sheet and place it at the front of this Mark 12A Maintenance Manual to indicate that the manual has been updated to include the latest Modulator-Power Units.

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INTRODUCTION.

The Modulator-Power Units, T (12) or T (24) MP-12A-1 and MP-12AH-1, provide both communication and intercommunication between pilot and co-pilot through a common power amplifier.

The remote-mounted Unit contains the power supply and audio-modulator. An auxiliary audio input circuit is provided so that one or more radio equipments may be connected to operate through the Unit. The audio input circuit is designed for a level of 50 milliwatts from a 300 ohm source.

These Units have been designed to be mounted either horizontally or vertically, by means of the mounting base supplied.

A gain control in the microphone input may be adjusted for full modulation with inputs of .06 to 0.5 volts from a 100 ohm source. This control is preset at the factory for carbon microphone levels.

HELICOPTER APPLICATION.

The suffix "AH" in the Unit's designation indicates that the Unit is for helicopter application.

The "AH" units are designed to be integrated with the cyclic's communication buttons.

Most helicoptors, due to noise levels, require the use of headphones and boom mikes. It is for this reason that the cyclic is provided with two communication buttons: (1) a comm switch, (2) an intercomm switch.

K-502, R-414, and C-509 in the "AH" Units provide delay in switching, eliminating the click in the headphones caused by the collapsing field in the Power Unit output transformer. The side-tone level has been adjusted with proper modulation level for listening comfort during transmission. Figure 38, illustrates the intercom circuit.

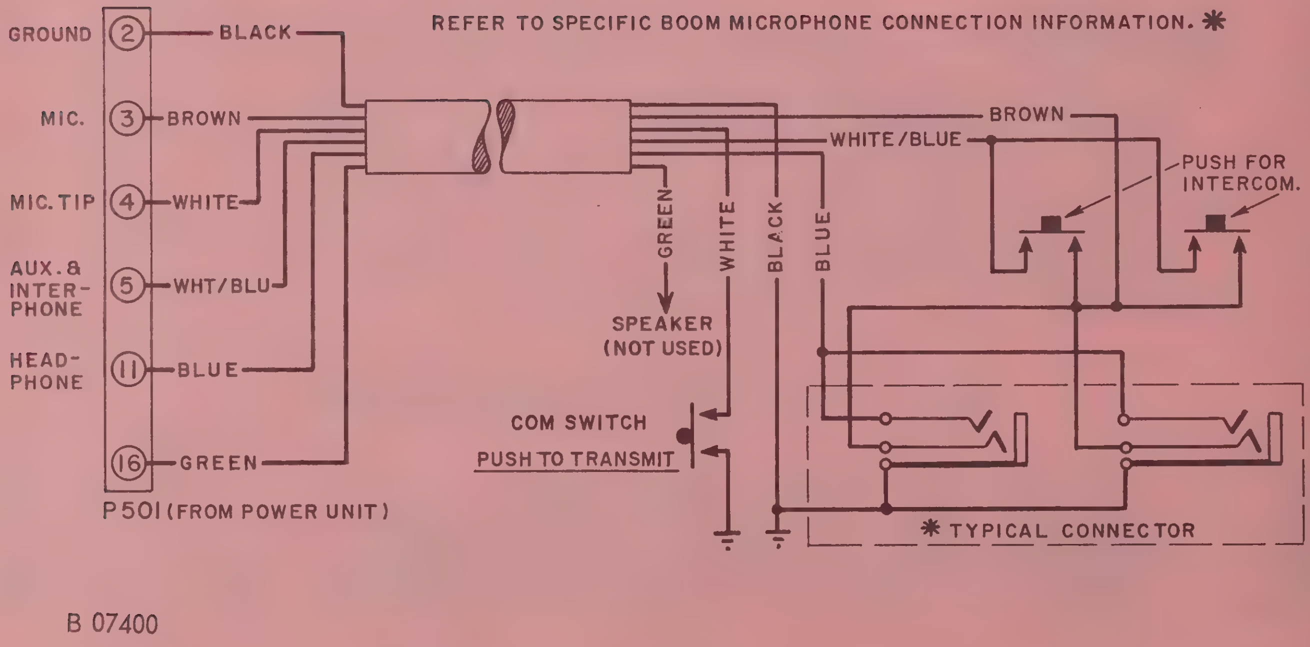

GROUND
MIC.
MIC. TIP
AUX. & INTER-PHONE
HEAD-PHONE
2
3
4
5
11
16
BLACK
BROWN
WHITE
WHT/BLU
BLUE
GREEN
P501 (FROM POWER UNIT)
REFER TO SPECIFIC BOOM MICROPHONE CONNECTION INFORMATION. ✱
BROWN
WHITE/BLUE
PUSH FOR INTERCOM.
GREEN
WHITE
BLACK
BLUE
SPEAKER (NOT USED)
COM SWITCH
PUSH TO TRANSMIT
✱ TYPICAL CONNECTOR
B 07400

FIGURE 38. T (12/24) MP-12AH-1 WIRING DIAGRAM

CIRCUIT DESCRIPTION.

Power Circuits (Modulator-Power Unit)

The power supply section uses two power transistors, Q-501 and Q-502, and a power transformer, T-501, in a circuit whose simplified operation is as follows. The instant primary voltage is applied (A+), because of the inevitable dissimilarity of the two transistors more current will flow in one than in the other. This greater flow of current through the feedback windings of the power transformer induces a voltage on the transistors such that the conducting unit is driven into greater conduction and the other is held at cut-off.

Almost instantly the transformer reaches saturation. Thus having reached maximum flux density, there is no more induced voltage in the bias windings which are connected to the transistor circuitry. Therefore, the current through the conducting transistor decreases, and bias voltage at opposite polarity is developed which cuts off this transistor and simultaneously causes the second transistor to conduct. The same procedure repeats with the second transistor. This switching action repeats at high speed and the resultant output voltage of T-501 is essentially a square wave.

A full wave bridge rectifier consisting of CR-501, CR-502, CR-503, and CR-504 in conjunction with the center tapped secondary of T-501 provides a simple means of obtaining a dual voltage output. Filtering of these DC voltages is easily accomplished because of the high frequency of the power supply.

Panel Unit Audio Circuits.

Audio signals from the two volume controls are combined in CP-302, then applied to the grid of the first audio amplifier, V-103-B. The amplified audio signal at the plate of V-103-B is applied to the base of Q-304 through a parallel tuned filter consisting of C-340 and L-317. This filter is tuned to 1020 cps. It presents a high impedance at this frequency to provide approximately 20 db rejection of the code identification tone transmitted by navigation stations. S-313, the push-pull switch attached to the NAV volume control, shorts out the filter when pulled. This permits the pilot to hear the code identification. When the knob is pushed in the tone is reduced to make voice transmissions more understandable. Q-304 is an emitter follower providing an impedance match to the audio power amplifier.

Audio Circuits ("A-1" Series).

The remainder of the audio circuit is located in the modulator/power unit. In the receive mode, the audio signal from Q-304 is switched by K-501 to the base of Q-401, the audio driver. The audio output is switched by K-501 to the speaker output lead, and is applied at all times to the headphone lead.

In the transmit mode, audio signal from the microphone is switched by K-501 to the base of Q-401. Audio output is taken from the modulation winding of T-402. In this case, K-501 switches B+ to the modulation winding to activate the transmitter.

Audio Circuits (AH-1 Series).

The audio circuits in the Modulator-Power Unit contains an additional time delay relay (K-502), incorporated in the speaker and phone output leads. The remainder of the circuit is unchanged.

In the transmit mode, relay K-503 activates relay K-502 and capacitor C-509, (which is across relay K-502s windings) begins to charge. When the transmitter is un-keyed, the charge on C-509 keeps K-502 closed for approximately 20 milliseconds, allowing the inductive kickback of the audio output transformer modulation secondary (T-402) to bleed off, thus preventing a loud unpleasant noise in the phones or speaker. Resistor R-413 is wired across contacts 3 and 5 of relay K-502 so that in the transmit mode, a headphone sidetone signal is provided.

MAINTENANCE SERVICE PROCEDURE MODULATOR-POWER UNIT.

The only control requiring adjustment is the microphone a gain control. It is adjusted at the factory for normal carbon microphones, and should need adjustment only if the MK-12A is to be used with a microphone providing a higher output level. If adjustment is required, proceed as follows:

Recommended Method (Bench Adjustment).

Connect the Unit to a primary power source. Connect the microphone to the modulator/power and accessory cable. Connect an oscilloscope to C-205 (feed-thru capacitor in left front corner of chassis.)

Connect a 50 ohm, 10 watt, dummy load to the COM antenna jack. If possible, have the pilot speak into the microphone in his normal manner. Turn the gain control fully counterclockwise. Key transmitter and, while speaking into the microphone, adjust the gain control until the positive and negative voice peaks, viewed on the oscilloscope, begin flattening.

Alternate Method (Adjustment in Aircraft).

Connect the microphone to the Mark 12A. Connect the common lead to a Simpson Model 260 VOM, or equivalent, to the Mark 12A chassis. Connect the probe to C-205, (feedthru capacitor in left front corner of the chassis). Set the VOM function selector to "output." Key the transmitter, and while speaking a sustained "ah" into the microphone, adjust the gain control for a reading of 60 to 75 volts on the VOM.

REPLACEMENT PARTS LIST

This Replacement Parts List provides a listing of all the replaceable parts of the Modulator-Power Units MP-12A-1 and MP-12AH-1 both 14 and 28 volts.

Due to the similarity between Units, all Units have been combined into one list. The Used On Column indicates which Unit the particular part is used on. When ALL is indicated, it means that the part is common to all the units described in the list heading. See figures 39 thru 42 for part location.

Modulator-Power Unit		Used On	See Figure
T (12) MP-12-A1	14V	A	39
T (24) MP-12-A1	28V	B	40
T (12) MP-12-AH-1	14V	C	41
T (24) MP-12-AH-1	28V	D	42

Item or Symbol No.	Narco Part No.	Description	Used On
		Mechanical Parts	
1	04238-9	Label, T(12)MP12A-1	A
1	04238-10	Label, T(24)MP12A-1	B
1	04238-11	Label, T(12)MP-12AH-1	C
1	04238-12	Label, T(24)MP-12AH-1	D
2	04139-3	Label, Warning	ALL
3	04284-1	Label, Mike Adjustment	ALL
4	56438-1	Cover, Dust (not shown)	ALL
5	56492-1	Chassis	ALL
6	56491-1	Panel, Front	ALL
7	56438-1	Panel, Rear	ALL
8	55020-2	Insulator, Transistor	ALL
9	56490-1	Shelf	ALL
10	81213-6	Spacer, Trans. Mount	ALL
11	81440-5	Tie Lug Strip, 10 Lug	ALL
12	81442-10	Tie Lung Strip, 6 Lug	ALL
13	81436-6	Tie Lug Strip, 9 Lug	ALL
14	81335-11	Insulator, Shoulder	ALL
15	81443-1	Tie Lug Strip, 5 Lug	ALL
16	81435-13	Tie Lug Strip, 8 Lug	ALL
17	81436-5	Tie Lug Strip, 9 Lug	ALL
18	81436-9	Tie Lug Strip, 9 Lug	ALL
19	66507-1	Fuseholder	ALL
20	82010-20	Clamp, Cable	ALL
21	56489-1	Bar, Pot Ganging	ALL
22	81213-65	Spacer, Pot Mounting	ALL
23	81213-64	Spacer, Sub-chassis	ALL

Item or Symbol No.	Narco Part No.	Description	Used on
		Electrical Parts	
C-401	21554-3	CAPACITOR, ELECTROLYTIC, 200 mfd, 15V	ALL
C-405	23078-273	CAPACTOR, MYLAR, .027 mfd ±5%, 1000V	ALL
C-406	21552-18	CAPACITOR, ELECTROLYTIC, 30 mfd, 15V	ALL
C-408	21552-18	CAPACITOR, ELECTROLYTIC, 30 mfd, 15V	C, D
C-501	21552-18	CAPACITOR, ELECTROLYTIC, 30 mfd, 15V	ALL
C-502	21556-1	CAPACITOR, ELECTROLYTIC, 40 mfd, 475V, 100 mfd, 250V, 20 mfd, 250V	ALL
C-505	23086-19	CAPACITOR, MYLAR, 2.0 mfd, 200V	ALL
C-506	21525-29	CAPACITOR, ELECTROLYTIC, 500 mfd, 35V	ALL
C-509	21554-3	CAPACITOR, ELECTROLYTIC, 200 mfd, 15V	C, D
CR-501	75204-45	DIODE, SILICON, 500 PIV	ALL
CR-502	75204-45	DIODE, SILICON, 500 PIV	ALL
CR-503	75204-45	DIODE, SILICON, 500 PIV	ALL
CR-504	75204-45	DIODE, SILICON, 500 PIV	ALL
CR-505	75204-45	DIODE, SILICON, 500 PIV	ALL
F-501	66504-12	FUSE, SLO/BLO, 10 amp	A, C
F-501	66504-10	FUSE, SLO/BLO, 6¼ amp	B, D
J-501	41181-4	CONNECTOR, PLUG, 16 pin	ALL
K-501	65126-23	RELAY	A, B
K-502	65134-1	RELAY	C, D
K-503	65134-2	RELAY	C, D
L-401	11814-3	INDUCTOR, FILTER	ALL
L-501	11449-1	CHOKE, 50 μh	ALL
Q-401	75571-2	TRANSISTOR, DRIVER	ALL
Q-402	75534-3	TRANSISTOR, AUDIO, OUTPUT	A, C
Q-402	75544-2	TRANSISTOR, AUDIO, OUTPUT	B, D
Q-403	75534-3	TRANSISTOR, AUDIO, OUTPUT	A, C
Q-403	75544-2	TRANSISTOR, AUDIO, OUTPUT	B, D
Q-501	75564-2	TRANSISTOR, POWER	ALL
Q-502	75564-2	TRANSISTOR, POWER	ALL
R-401	31141-103	RESISTOR, FIXED, COMPOSITION, 10K ±10%, ½W	ALL
R-402	31141-472	RESISTOR, FIXED, COMPOSITIOIN, 4.7K ±10%, ½W	ALL
R-403	31187-1	RESISTOR, TEMPERATURE, SENSITIVE, 0.24 ohm ±10%, +T.C.	A, C
R-403	31179-1	RESISTOR, TEMPERATURE, SENSITIVE, 0.47 ohm ±10%, +T.C.	B, D
R-404	31141-471	RESISTOR, FIXED,COMPOSITION, 470 ohm ±10%, ½W	ALL
R-405	31141-689	RESISTOR, FIXED, COMPOSITION, 6.8 ohm ±10%, ½W	A, C
R-405	31141-829	RESISTOR, FIXED, COMPOSITION, 8.2 ohm ±10%, ½W	B, D
R-406	31136-103	RESISTOR, FIXED, COMPOSITION, 10K ±10%, 2W	ALL
R-408	31141-822	RESISTOR, FIXED, COMPOSITION, 8.2K ±10%, ½W	A, B
R-408	31141-471	RESISTOR, FIXED, COMPOSITION, 470 ohm ±10%, ½W	C, D
R-409	31175-11	RESISTOR, WIREWOUND, 75 ohm ±5%, 5W	B, D
R-410	32045-13	RESISTOR, VARIABLE, Wirewound, 200 ohm, 2W	ALL
R-411	32045-13	RESISTOR, VARIABLE, Wirewound, 200 ohm, 2W	ALL
R-412	31175-22	RESISTOR, WIREWOUND, 1K ohm ±10%, 5W	ALL
R-413	31141-332	RESISTOR, FIXED, COMPOSITION, 3.3K ±10%, ½W	C, D
R-414	31141-220	RESISTOR, FIXED, COMPOSITION, 22 ohm ±10%, ½W	C, D
R-415	31141-100	RESISTOR, FIXED, COMPOSITION, 10 ohm ±10%, ½W	A, C
R-415	31141-180	RESISTOR, FIXED, COMPOSITION, 18 ohm ±10%, ½W	B, D
R-416	31141-102	RESISTOR, FIXED, COMPOSITION, 1K ±10%, ½W	A, C
R-416	31141-331	RESISTOR, FIXED, COMPOSITION, 330 ohm ±10%, ½W	B, D
R-417	33002-109	RESISTOR, WIRE ADJUSTABLE, 1 ohm, 10W	A, C
R-417	33002-309	RESISTOR, WIRE ADJUSTABLE, 3 ohm, 10W	B, D
R-418	31141-102	RESISTOR, FIXED, COMPOSITION, 1K ±10%, ½W	ALL
R-501	31136-471	RESISTOR, FIXED, COMPOSITION, 470 ohm ±10%, 2W	ALL
R-502	31175-24	RESISTOR, WIREWOUND, 10 ohm ±10%, 7W	A, C
R-502	31136-220	RESISTOR, FIXED, COMPOSITION, 22 ohm ±10%, 2W	B, D
R-503	31141-229	RESISTOR, FIXED, COMPOSITION, 2.2 ohm ±10%, ½W	A, C
R-505	31135-274	RESISTOR, FIXED, COMPOSITION, 270K ±10%, 1W	ALL
R-506	31136-101	RESISTOR, FIXED, COMPOSITION, 100 ohm ±10%, 2W	ALL
R-507	31175-11	RESISTOR, WIREWOUND, 75 ohm ±5%, 5W	B
R-511	31157-6	RESISTOR, WIREWOUND, 42 ohm ±5%, 7W	D
T-401	11706-2	TRANSFORMER, AUDIO, Transistor Driver	ALL
T-402	11704-2	TRANSFORMER, AUDIO, OUTPUT, 14 Volt	A, C
T-402	11705-2	TRANSFORMER, AUDIO OUTPUT, 28 Volt	B, D
T-501	11697-1	TRANSFORMER, POWER, 14 Volt	A, C
T-501	11698-1	TRANSFORMER, POWER, 28 Volt	B, D

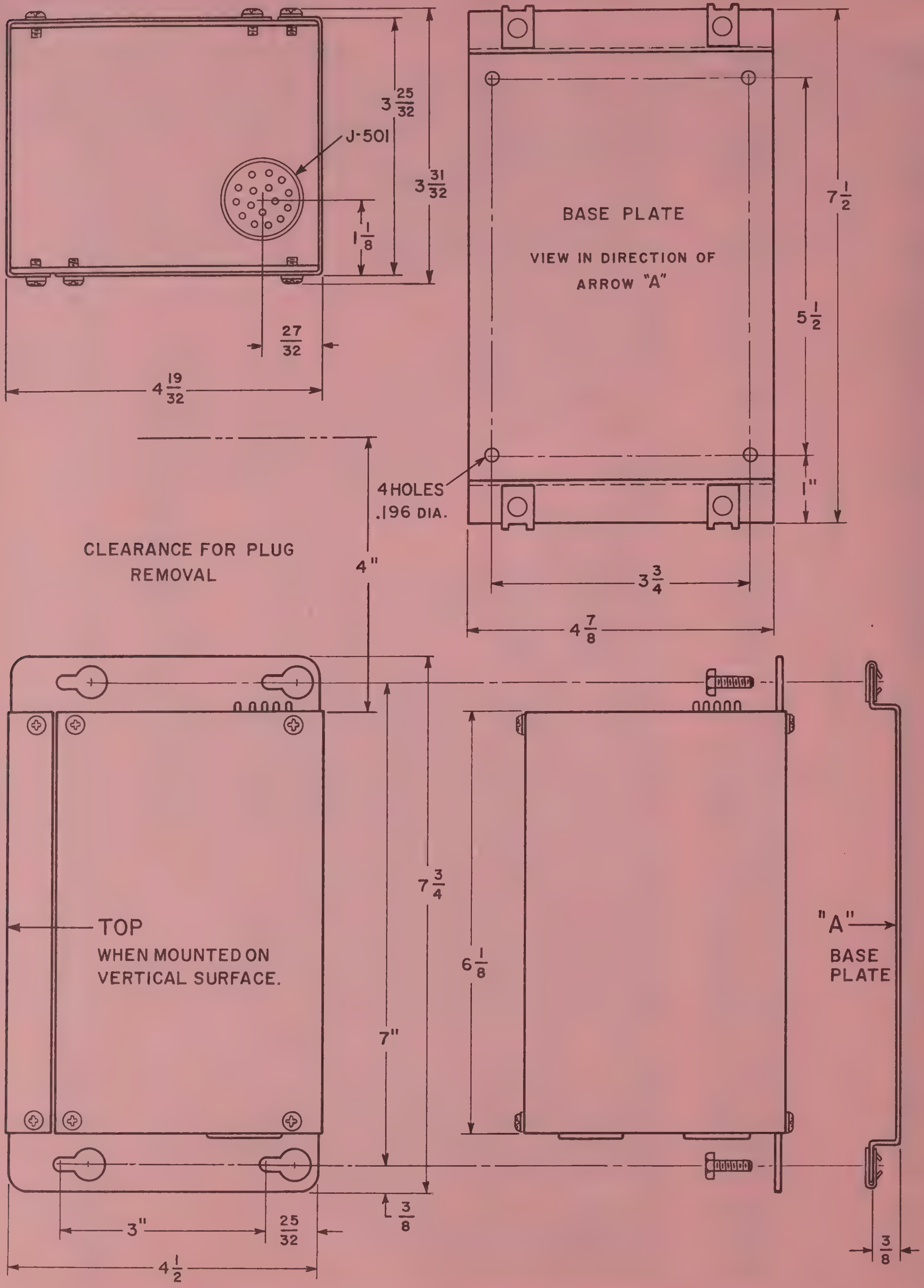
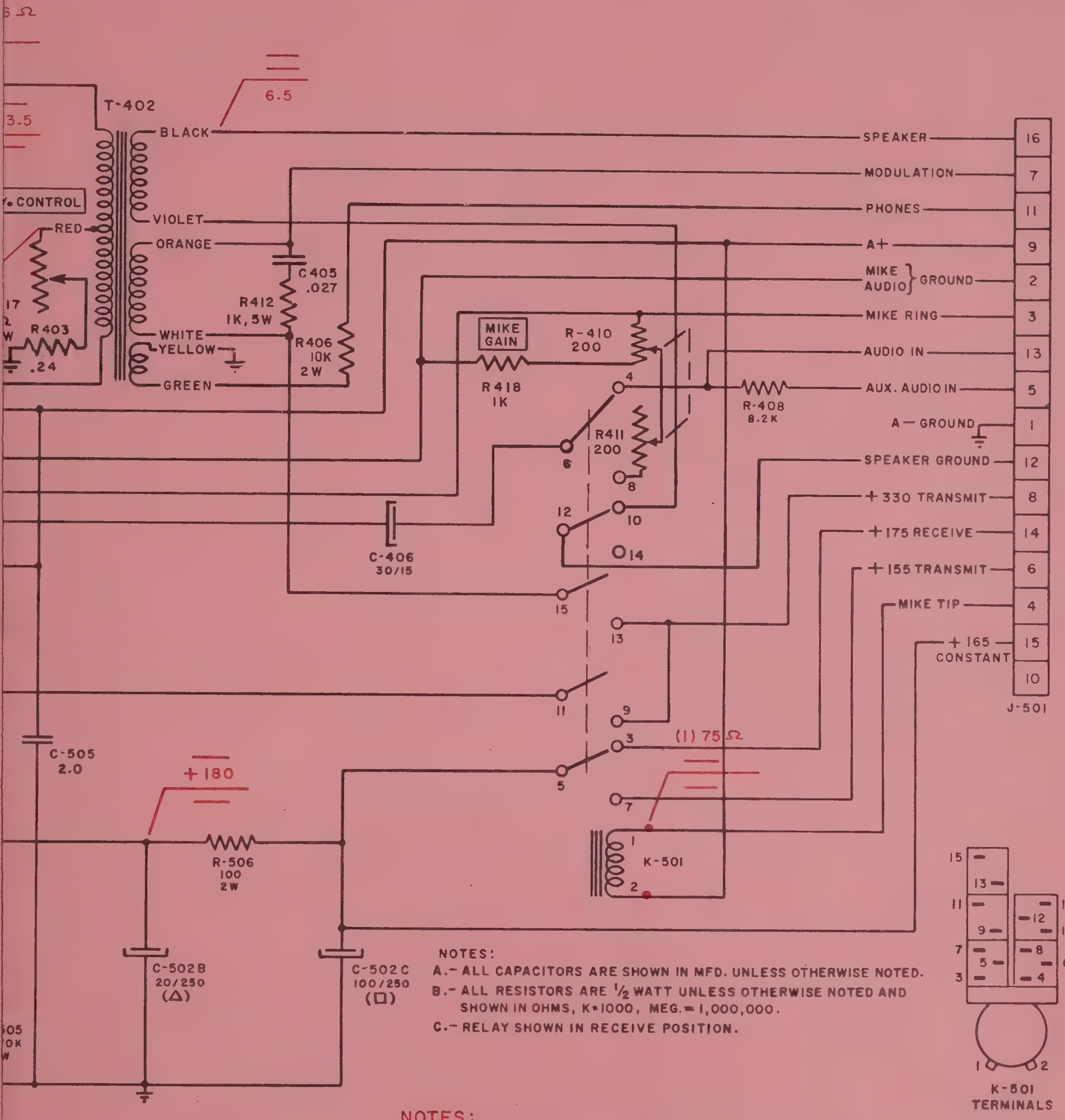

3 25/32
J-501
3 31/32
1 1/8
27/32
4 19/32
BASE PLATE
VIEW IN DIRECTION OF ARROW "A"
7 1/2
5 1/2
1"
4 HOLES .196 DIA.
3 3/4
4 7/8
CLEARANCE FOR PLUG REMOVAL
4"
TOP
WHEN MOUNTED ON VERTICAL SURFACE.
7 3/4
7"
6 1/8
"A"
BASE PLATE
3"
25/32
3/8
4 1/2
3/8

FIGURE 38A. MODULATOR-POWER UNIT INSTALLATION DRAWING (TYPICAL)



Ω
6.5
3.5
T-402
BLACK
CONTROL
VIOLET
RED
ORANGE
17
R403
.24
WHITE
YELLOW
GREEN
C405
.027
R412
1K, 5W
R406
10K
2W
MIKE GAIN
R-410
200
R418
1K
R411
200
R-408
8.2K
C-406
30/15
4
6
8
10
12
14
15
13
11
9
3
5
7
(1) 75 Ω
K-501
1
2
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A — GROUND
SPEAKER GROUND
+ 330 TRANSMIT
+ 175 RECEIVE
+ 155 TRANSMIT
MIKE TIP
+ 165 CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
C-505
2.0
+ 180
R-506
100
2W
C-502B
20/250
(Δ)
C-502C
100/250
(□)
505
OK
W
15
13
11
14
12
10
9
7
5
8
6
3
4
1
2
K-501 TERMINALS

NOTES:

A.– ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.– ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.=1,000,000.

C.– RELAY SHOWN IN RECEIVE POSITION.

PIN 9.
WHITE
SIS

TEST DATA

DC RESISTANCE

DC VOLTAGE & POLARITY

AC VOLTAGE OR WAVESHAPE & P-P VOLTAGE

NOTES:

1. RESISTANCE READINGS MEASURED WITH CABLE CONNECTOR REMOVED FROM J-501.
2. ALL OTHER READINGS MEASURED WITH PANEL UNIT MK.12A CONNECTED WITH 8 FT. CABLE, 13.75 VOLTS DC INPUT TO CABLE WIRE, RECEIVE OPERATION AND 10 WATTS 1000 Hz, OUTPUT FROM SPEAKER TERMINAL.
3. ALL DC MEASUREMENTS WITH RCA VOLTOMYST OR EQUIVALENT.
4. ALL AC MEASUREMENTS WITH BALLANTINE VTVM OR EQUIVALENT.
5. ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUAL.

FIGURE 39. MODULATOR-POWER UNIT, T(12) MP-12A-1
(Drawing and Schematic)

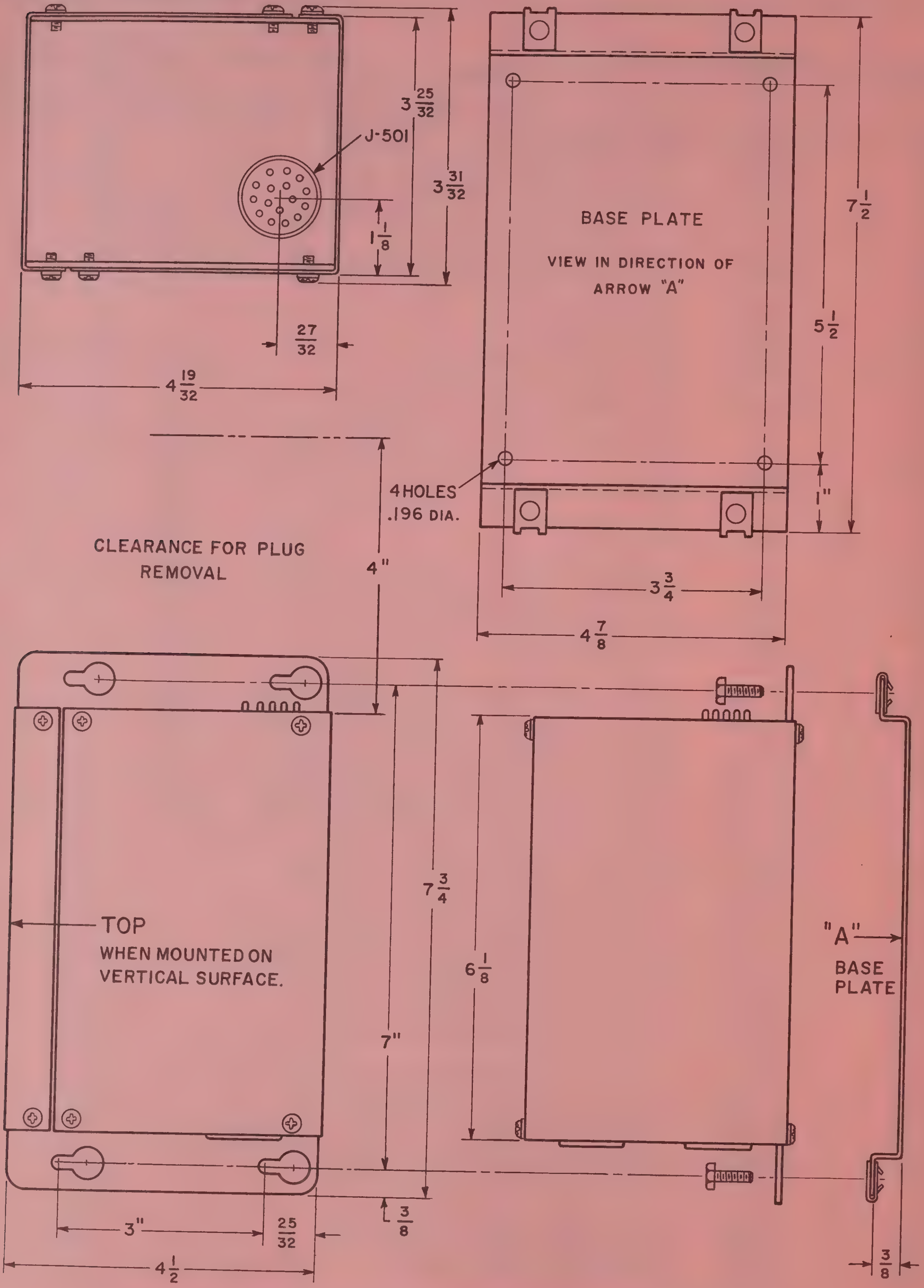
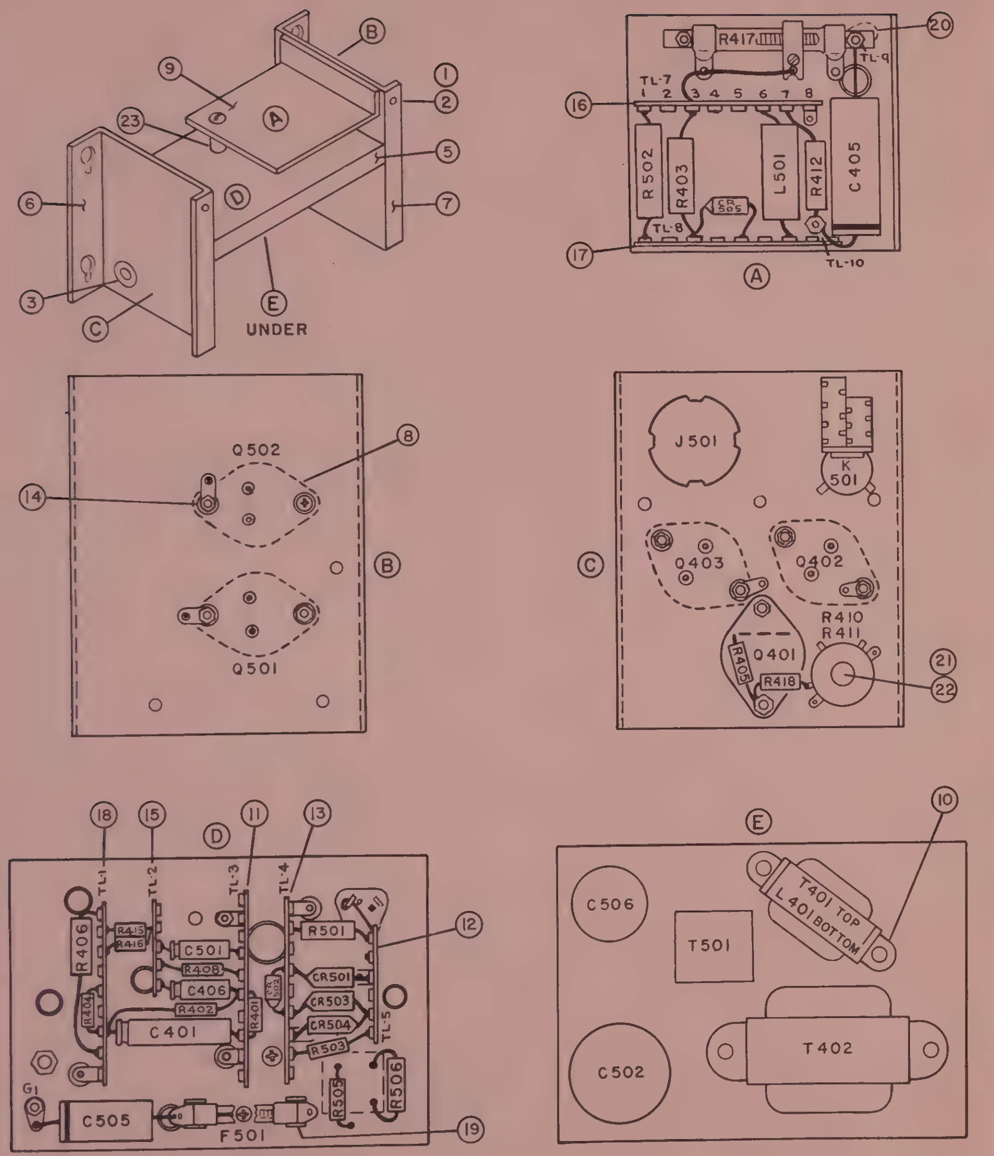
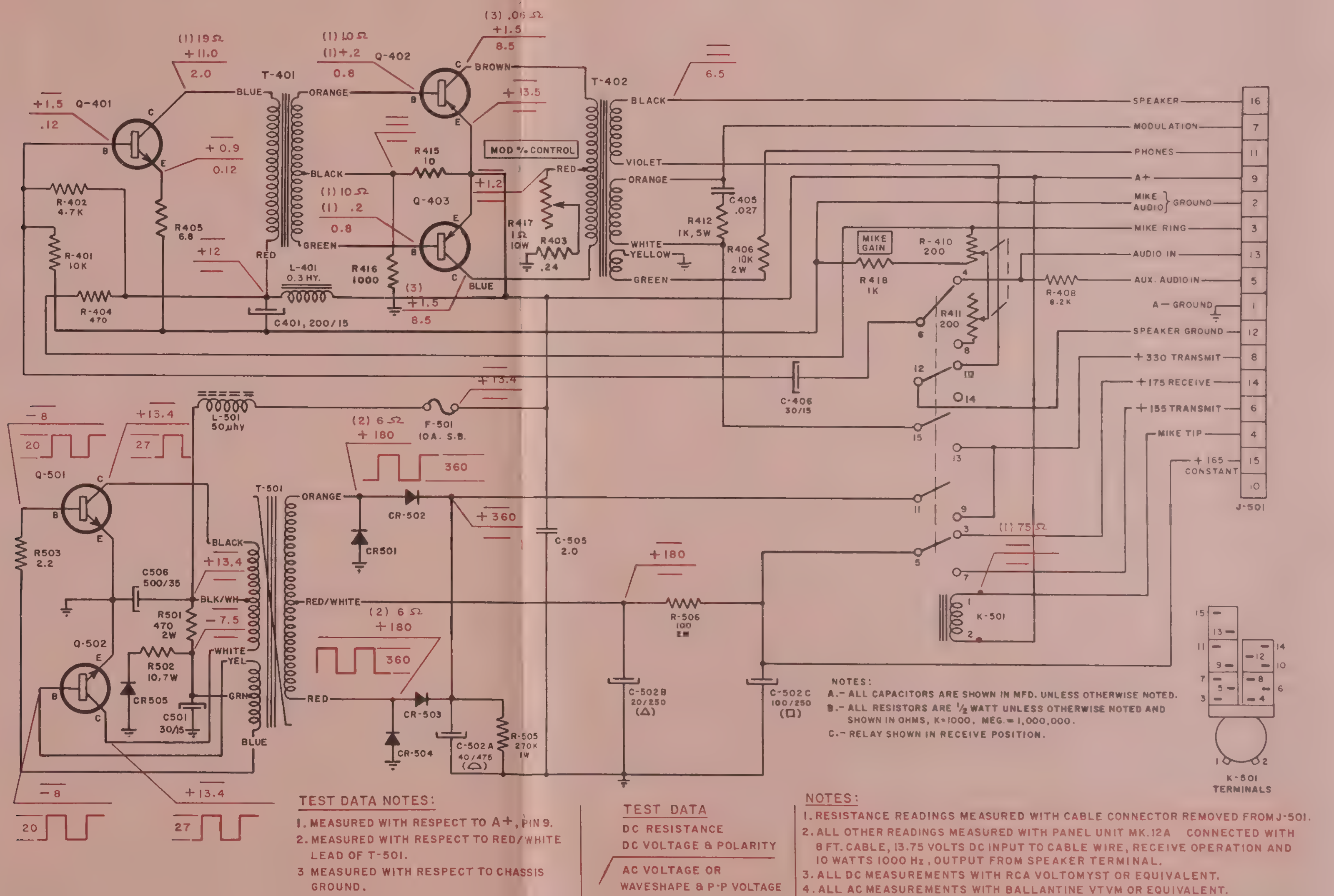

J-501
3 25/32
3 31/32
1 1/8
27/32
4 19/32
BASE PLATE
VIEW IN DIRECTION OF ARROW "A"
7 1/2
5 1/2
1"
4 HOLES .196 DIA.
3 3/4
4 7/8
CLEARANCE FOR PLUG REMOVAL
4"
TOP
WHEN MOUNTED ON VERTICAL SURFACE.
7 3/4
7"
6 1/8
"A"
BASE PLATE
3/8
3"
25/32
4 1/2
3/8

FIGURE 38A. MODULATOR-POWER UNIT INSTALLATION DRAWING (TYPICAL)


A
B
C
D
E
UNDER
R417
TL-7
TL-8
TL-9
TL-10
R502
R403
CR505
L501
R412
C405
Q502
Q501
J501
K 501
Q403
Q402
Q401
R410
R411
R405
R418
TL-1
TL-2
TL-3
TL-4
TL-5
R406
R415
R416
C501
R408
C406
R402
C401
R401
R501
CR501
CR503
CR504
R503
R505
R506
C505
F501
G1
C506
T501
T401 TOP
L401 BOTTOM
C502
T402

PARTS LOCATION DRAWING


Q-401
Q-402
Q-403
Q-501
Q-502
T-401
T-402
T-501
L-401 0.3 HY.
L-501 50µhy
C401, 200/15
R-401 10K
R-402 4.7K
R-404 470
R405 6.8
R415 10
R416 1000
R417 1Ω 10W
R403 .24
MOD % CONTROL
R412 1K, 5W
C405 .027
R406 10K 2W
MIKE GAIN
R418 1K
R-410 200
R411 200
R-408 8.2K
C-406 30/15
F-501 10A. S.B.
CR-502
CR501
C-505 2.0
R503 2.2
C506 500/35
R501 470 2W
R502 10.7W
CR505
C501 30/15
CR-503
CR-504
C-502A 40/475
R-505 270K 1W
C-502B 20/250
R-506 100 5W
C-502C 100/250
K-501
J-501
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A— GROUND
SPEAKER GROUND
+330 TRANSMIT
+175 RECEIVE
+155 TRANSMIT
MIKE TIP
+165 CONSTANT
K-501 TERMINALS
BLUE
ORANGE
BLACK
GREEN
RED
BROWN
VIOLET
WHITE
YELLOW
RED/WHITE
BLK/WH
+1.5
.12
(1) 19Ω
+11.0
2.0
(1) 10Ω
(1) +.2
0.8
(3) .06Ω
+1.5
8.5
+13.5
6.5
+0.9
0.12
+12
+1.2
(3)
+1.5
8.5
+13.4
−8
20
+13.4
27
(2) 6Ω
+180
360
+360
−7.5
+180
(1) 75Ω

TEST DATA NOTES:

1. MEASURED WITH RESPECT TO A+, PIN 9.
2. MEASURED WITH RESPECT TO RED/WHITE LEAD OF T-501.
3 MEASURED WITH RESPECT TO CHASSIS GROUND.

TEST DATA

DC RESISTANCE

DC VOLTAGE & POLARITY

AC VOLTAGE OR WAVESHAPE & P-P VOLTAGE

NOTES:

A.– ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

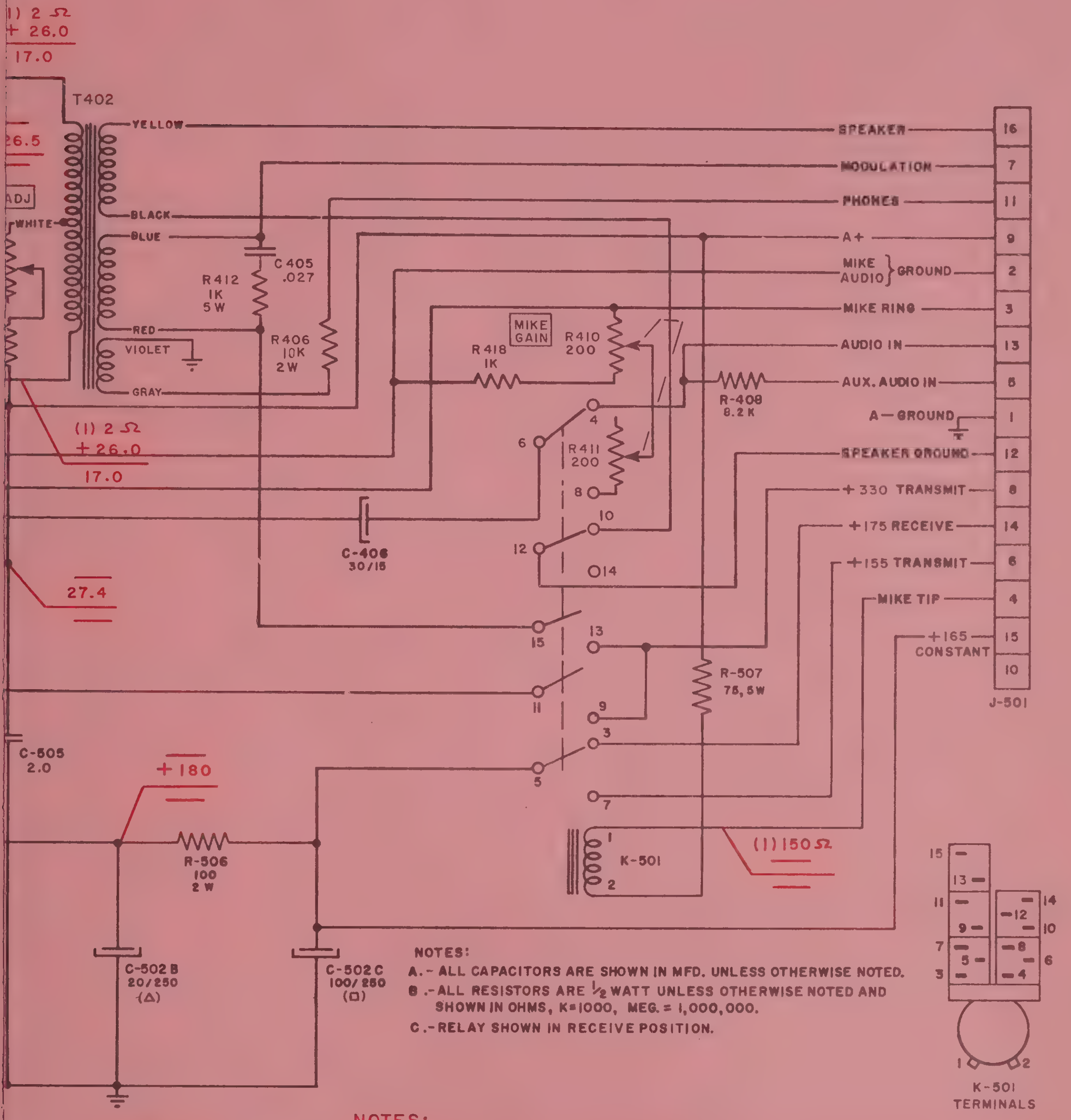
B.– ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.=1,000,000.

C.– RELAY SHOWN IN RECEIVE POSITION.

NOTES:

1. RESISTANCE READINGS MEASURED WITH CABLE CONNECTOR REMOVED FROM J-501.
2. ALL OTHER READINGS MEASURED WITH PANEL UNIT MK.12A CONNECTED WITH 8 FT. CABLE, 13.75 VOLTS DC INPUT TO CABLE WIRE, RECEIVE OPERATION AND 10 WATTS 1000 Hz, OUTPUT FROM SPEAKER TERMINAL.
3. ALL DC MEASUREMENTS WITH RCA VOLTOMYST OR EQUIVALENT.
4. ALL AC MEASUREMENTS WITH BALLANTINE VTVM OR EQUIVALENT.
5. ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUAL.

FIGURE 39. MODULATOR-POWER UNIT, T(12) MP-12A-1
(Drawing and Schematic)


(1) 2 Ω
+ 26.0
17.0
T402
26.5
ADJ
YELLOW
WHITE
BLACK
BLUE
RED
VIOLET
GRAY
R412
1K
5 W
C405
.027
R406
10K
2 W
R418
1K
MIKE GAIN
R410
200
R411
200
R-408
8.2 K
(1) 2 Ω
+ 26.0
17.0
27.4
C-406
30/15
C-505
2.0
+ 180
R-506
100
2 W
C-502 B
20/250
(△)
C-502 C
100/250
(□)
R-507
75, 5 W
K-501
(1) 150 Ω
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A — GROUND
SPEAKER GROUND
+ 330 TRANSMIT
+ 175 RECEIVE
+ 155 TRANSMIT
MIKE TIP
+ 165 CONSTANT
16
7
11
9
2
3
13
5
1
12
8
14
6
4
15
10
J-501
K-501
TERMINALS

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG. = 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

TEST DATA

DC RESISTANCE

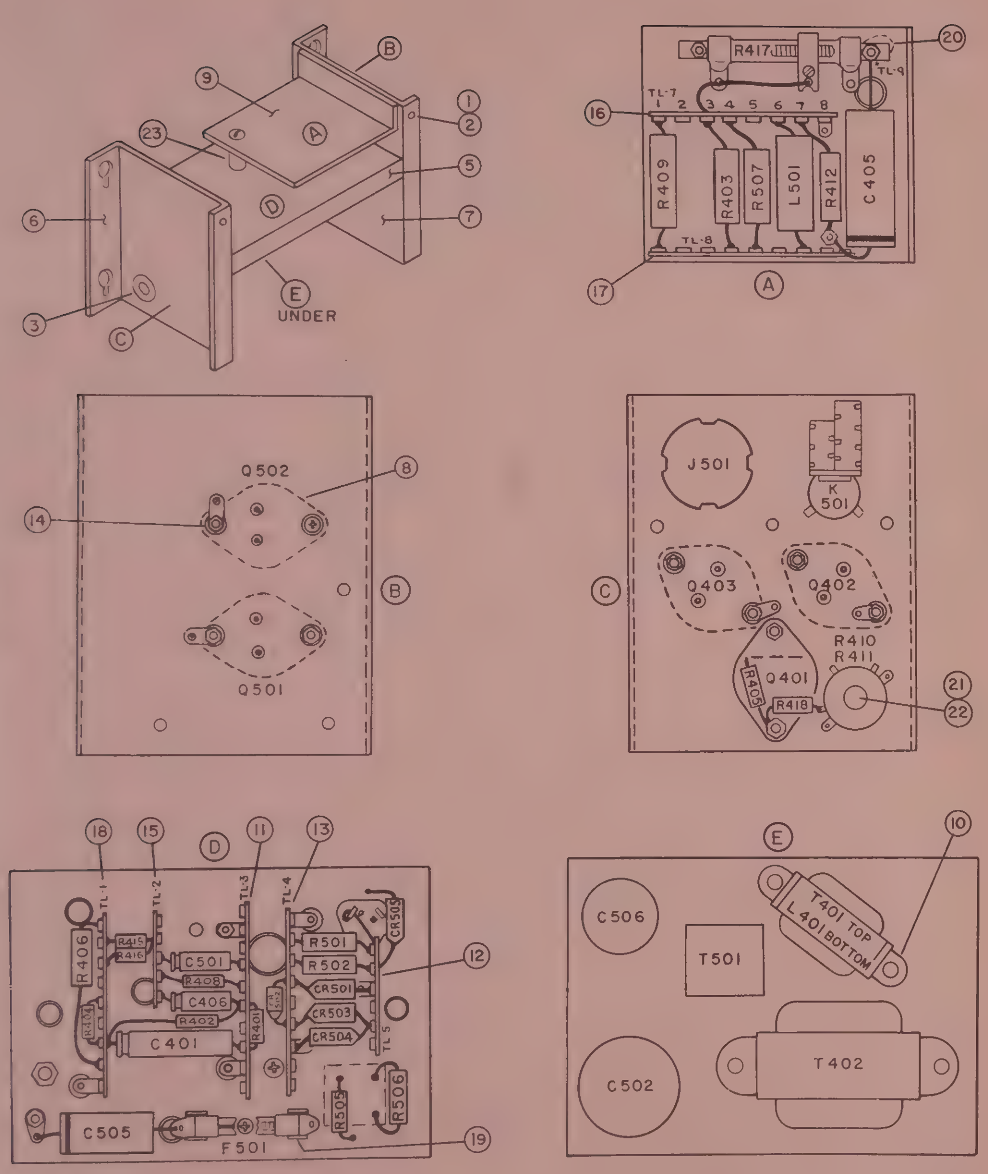
DC VOLTAGE & POLARITY

AC VOLTAGE OR WAVESHAPE & P-P VOLTAGE

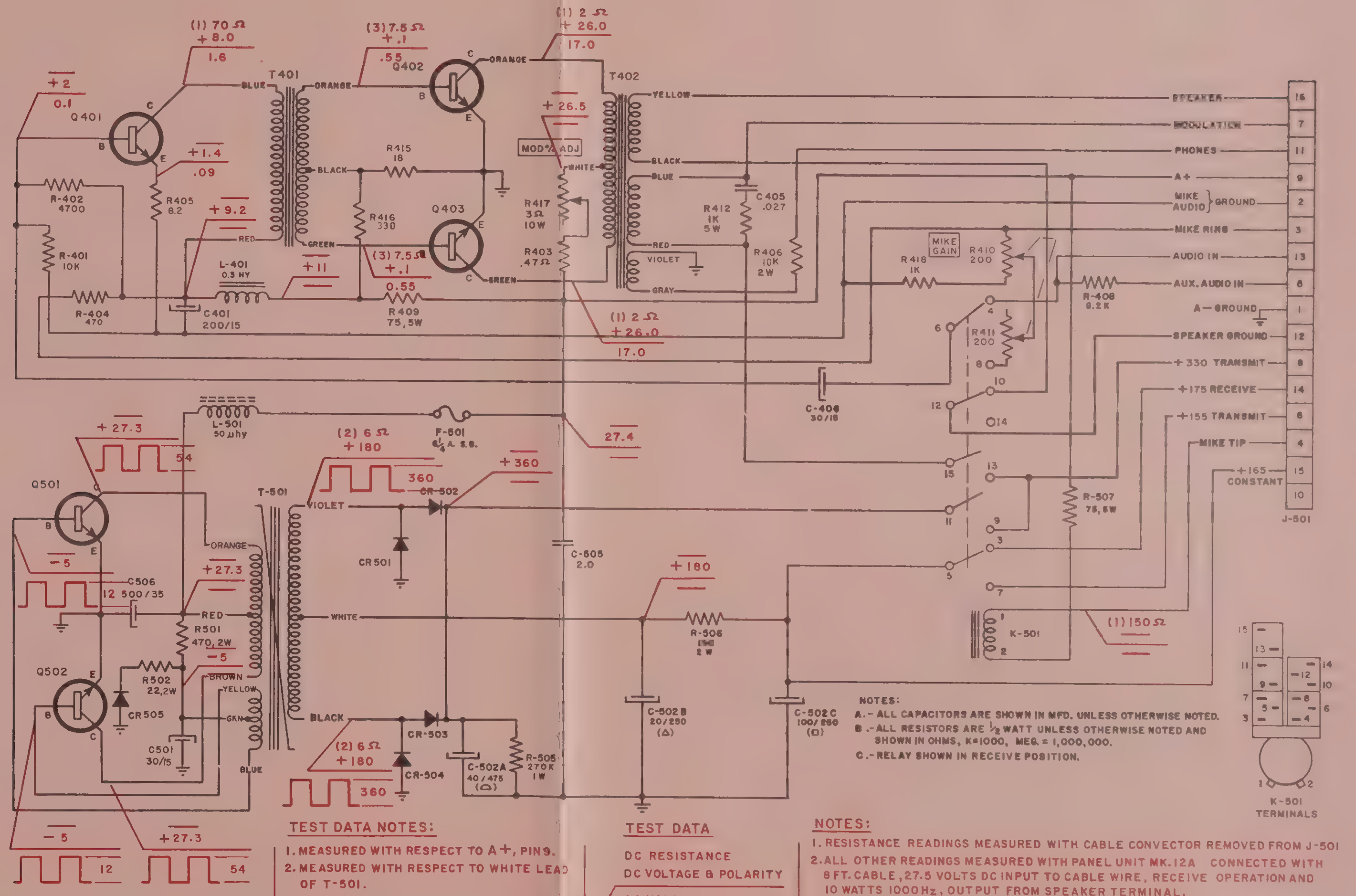
NOTES:

1. RESISTANCE READINGS MEASURED WITH CABLE CONVECTOR REMOVED FROM J-501
2. ALL OTHER READINGS MEASURED WITH PANEL UNIT MK.12A CONNECTED WITH 8 FT. CABLE, 27.5 VOLTS DC INPUT TO CABLE WIRE, RECEIVE OPERATION AND 10 WATTS 1000 Hz, OUTPUT FROM SPEAKER TERMINAL.
3. ALL DC MEASUREMENTS WITH RCA VOLTOMYST OR EQUIVALENT.
4. ALL AC MEASUREMENTS WITH BALLANTINE VTVM OR EQUIVALENT.
5. ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUAL.

FIGURE 40. MODULATOR-POWER UNIT, T (24) MP-12A-1
(Drawing and Schematic)


A
B
C
D
E
UNDER
R417
TL-7
TL-8
TL-9
R409
R403
R507
L501
R412
C405
Q502
Q501
J501
K501
Q403
Q402
Q401
R405
R418
R410
R411
TL-1
TL-2
TL-3
TL-4
TL-5
R406
R415
R416
C501
R408
C406
R402
C401
R401
R501
R502
CR501
CR503
CR504
CR505
R505
R506
C505
F501
C506
T501
T401 TOP
L401 BOTTOM
C502
T402

PARTS LOCATION DRAWING


Q401
Q402
Q403
Q501
Q502
T401
T402
T-501
R-402 4700
R-401 10K
R-404 470
R405 8.2
R415 18
R416 330
R409 75,5W
L-401 0.3 HY
C401 200/15
R417 3Ω 10W
R403 .47Ω
MOD% ADJ
R412 1K 5W
C405 .027
R406 10K 2W
R418 1K
MIKE GAIN
R410 200
R411 200
R-408 8.2K
C-406 30/15
R-507 75,5W
L-501 50 µhy
F-501 6¼ A. S.B.
C-505 2.0
CR501
CR-502
CR-503
CR-504
CR505
C506 500/35
R501 470, 2W
R502 22,2W
C501 30/15
R-506 15K 2W
C-502B 20/250
C-502A 40/475
C-502C 100/250
R-505 270K 1W
K-501
J-501
K-501 TERMINALS
ORANGE
YELLOW
BLACK
BLUE
GREEN
RED
WHITE
VIOLET
GRAY
BROWN
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO
GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A- GROUND
SPEAKER GROUND
+330 TRANSMIT
+175 RECEIVE
+155 TRANSMIT
MIKE TIP
+165 CONSTANT
(1) 70 Ω
+8.0
1.6
(3) 7.5 Ω
+.1
.55
(1) 2 Ω
+26.0
17.0
+2
0.1
+1.4
.09
+9.2
+11
+26.5
0.55
27.4
+27.3
54
(2) 6 Ω
+180
360
+360
-5
12
(1) 150 Ω

NOTES:

A.- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.- ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.

C.- RELAY SHOWN IN RECEIVE POSITION.

TEST DATA NOTES:

1. MEASURED WITH RESPECT TO A+, PIN 9.
2. MEASURED WITH RESPECT TO WHITE LEAD OF T-501.
3. MEASURED WITH RESPECT TO CHASSIS GROUND.

TEST DATA

DC RESISTANCE
DC VOLTAGE & POLARITY
AC VOLTAGE OR WAVESHAPE & P-P VOLTAGE

NOTES:

1. RESISTANCE READINGS MEASURED WITH CABLE CONVECTOR REMOVED FROM J-501
2. ALL OTHER READINGS MEASURED WITH PANEL UNIT MK.12A CONNECTED WITH 8 FT. CABLE, 27.5 VOLTS DC INPUT TO CABLE WIRE, RECEIVE OPERATION AND 10 WATTS 1000Hz, OUTPUT FROM SPEAKER TERMINAL.
3. ALL DC MEASUREMENTS WITH RCA VOLTOMYST OR EQUIVALENT.
4. ALL AC MEASUREMENTS WITH BALLANTINE VTVM OR EQUIVALENT.
5. ALL WAVEFORMS OBSERVED WITH TEKTRONIX 515A OSCILLOSCOPE OR EQUAL.

FIGURE 40. MODULATOR-POWER UNIT, T (24) MP-12A-1
(Drawing and Schematic)

TEST POINTS

See Fig. 39 for test points and values.

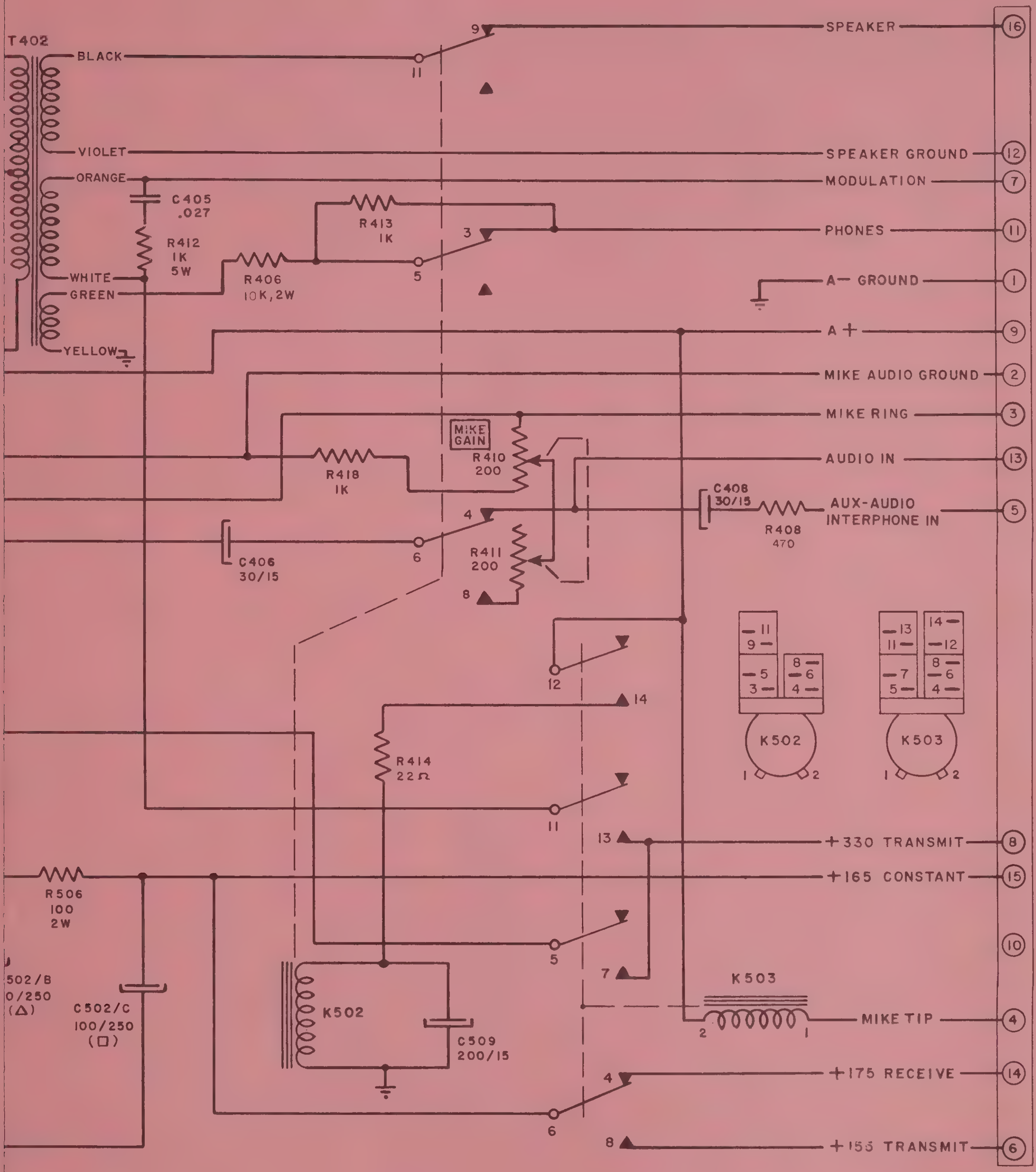
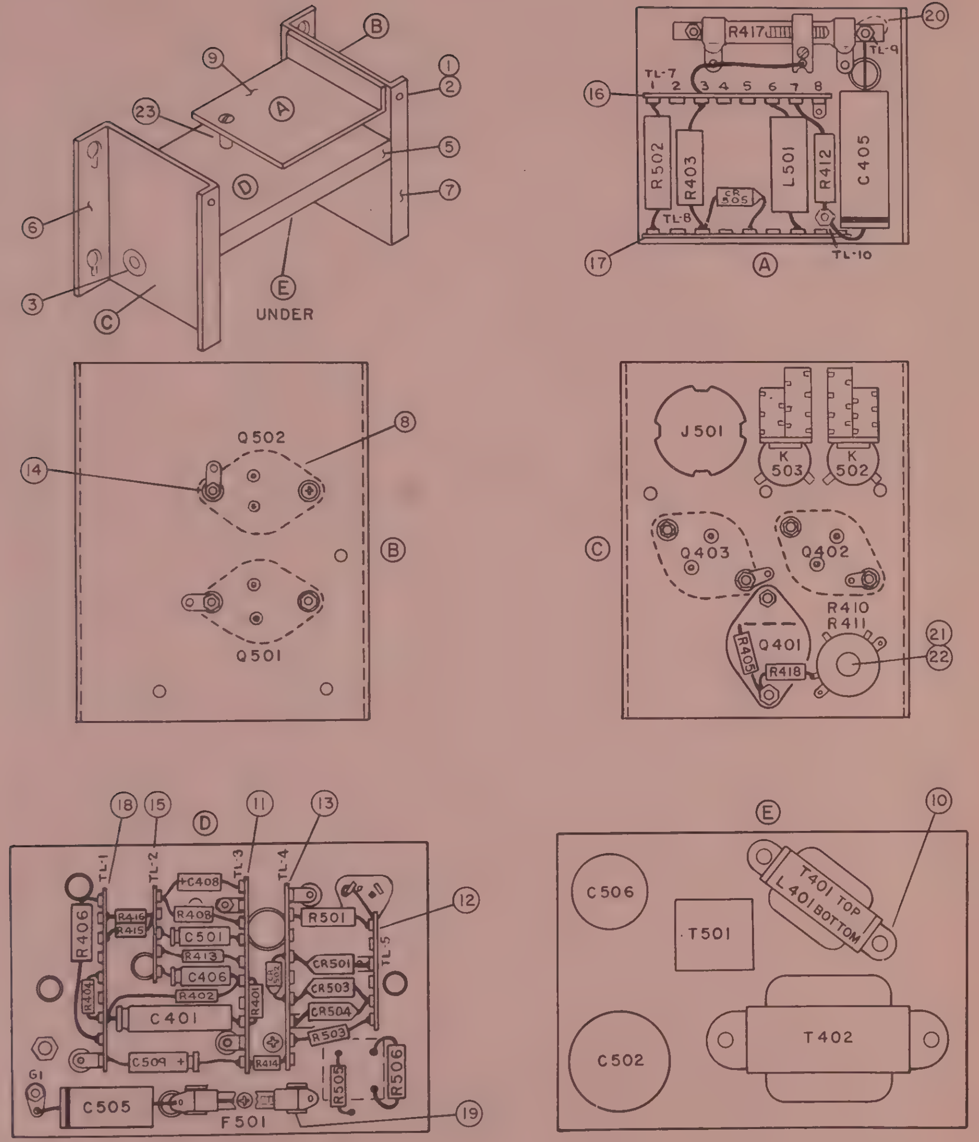
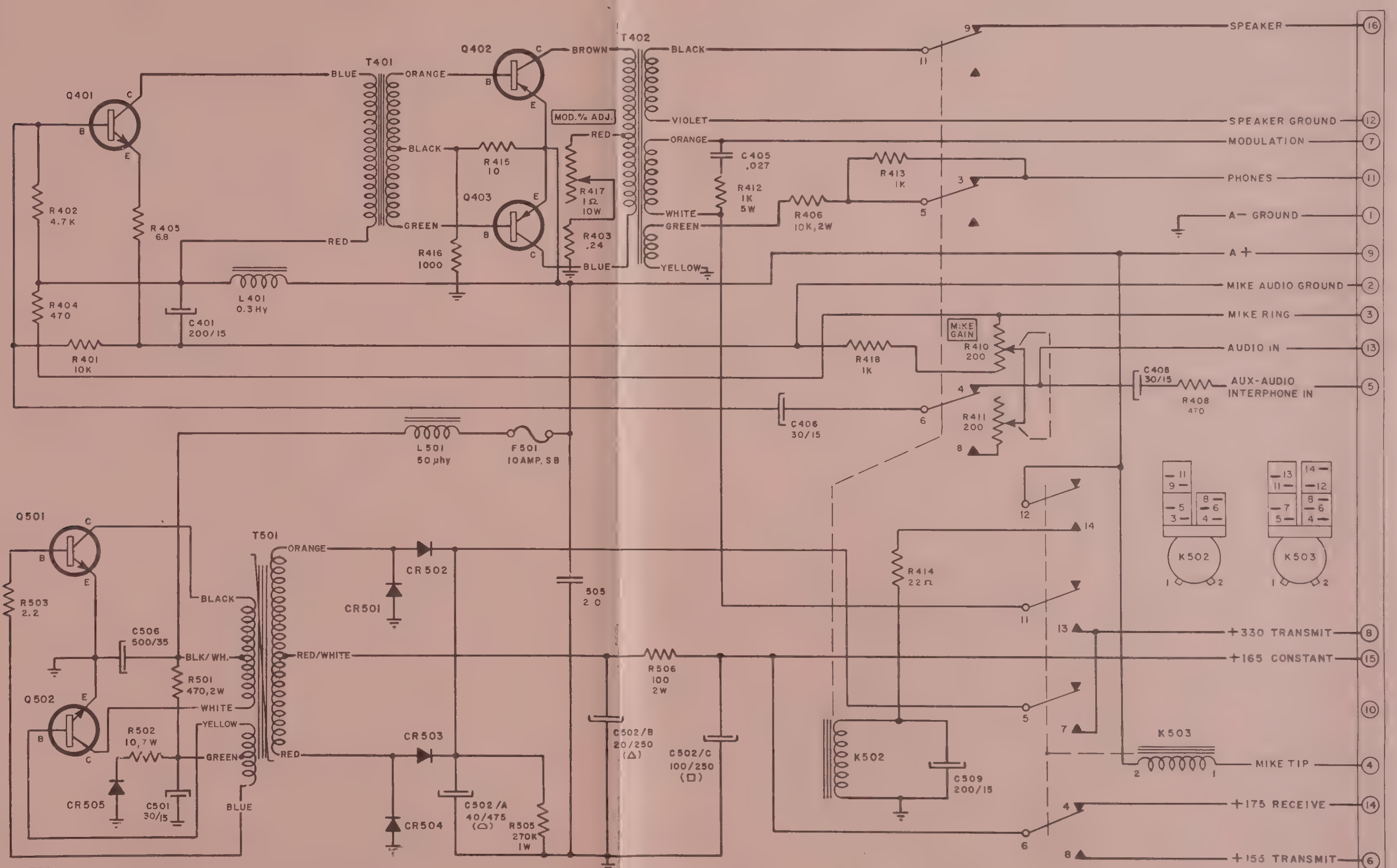

T402
BLACK
VIOLET
ORANGE
WHITE
GREEN
YELLOW
C405 .027
R412 1K 5W
R413 1K
R406 10K, 2W
MIKE GAIN
R410 200
R418 1K
C406 30/15
R411 200
C408 30/15
R408 470
R414 22Ω
R506 100 2W
502/B 0/250 (△)
C502/C 100/250 (□)
K502
C509 200/15
K503
SPEAKER
SPEAKER GROUND
MODULATION
PHONES
A− GROUND
A +
MIKE AUDIO GROUND
MIKE RING
AUDIO IN
AUX-AUDIO INTERPHONE IN
+330 TRANSMIT
+165 CONSTANT
MIKE TIP
+175 RECEIVE
+155 TRANSMIT
16
12
7
11
1
9
2
3
13
5
8
15
10
4
14
6

FIGURE 41. MODULATOR-POWER UNIT, T (12) MP-12AH-1
(Drawing and Schematic)

TEST POINTS
See Fig. 39 for test points and values.


A
B
C
D
E
UNDER
R417
TL-7
TL-8
TL-9
TL-10
R502
R403
CR405
L501
R412
C405
Q502
Q501
J501
K503
K502
Q403
Q402
Q401
R405
R418
R410
R411
TL-1
TL-2
TL-3
TL-4
TL-5
R406
R416
R415
R404
C408
R408
C501
R413
C406
R402
C401
R401
R501
CR501
CR503
CR504
R503
C509
R414
R505
R506
C505
F501
G1
C506
T501
T401 TOP
L401 BOTTOM
C502
T402

PARTS LOCATION DRAWING


Q401
Q402
Q403
T401
T402
MOD.% ADJ.
R402 4.7K
R405 6.8
R404 470
R401 10K
C401 200/15
L401 0.3Hy
R415 10
R416 1000
R417 1Ω 10W
R403 .24
C405 .027
R412 1K 5W
R406 10K, 2W
R413 1K
R418 1K
MIKE GAIN
R410 200
R411 200
C406 30/15
C408 30/15
R408 470
L501 50 μhy
F501 10AMP. SB
Q501
Q502
T501
R503 2.2
C506 500/35
R501 470, 2W
R502 10, 7W
C501 30/15
CR505
CR501
CR502
CR503
CR504
505 2.0
C502/A 40/475 (○)
R505 270K 1W
R506 100 2W
C502/B 20/250 (△)
C502/C 100/250 (□)
R414 22Ω
K502
C509 200/15
K503
SPEAKER
SPEAKER GROUND
MODULATION
PHONES
A− GROUND
A+
MIKE AUDIO GROUND
MIKE RING
AUDIO IN
AUX-AUDIO INTERPHONE IN
+330 TRANSMIT
+165 CONSTANT
MIKE TIP
+175 RECEIVE
+155 TRANSMIT
BLUE
ORANGE
BLACK
GREEN
RED
BROWN
VIOLET
WHITE
YELLOW
RED/WHITE
BLK/WH.

NOTES:
A– ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.
B– ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS,
K = 1000 MEG = 1,000,000
C– RELAYS SHOWN IN RECEIVE POSITION.

FIGURE 41. MODULATOR-POWER UNIT, T (12) MP-12AH-1
(Drawing and Schematic)

TEST POINTS

See Fig. 40 for test points and values.

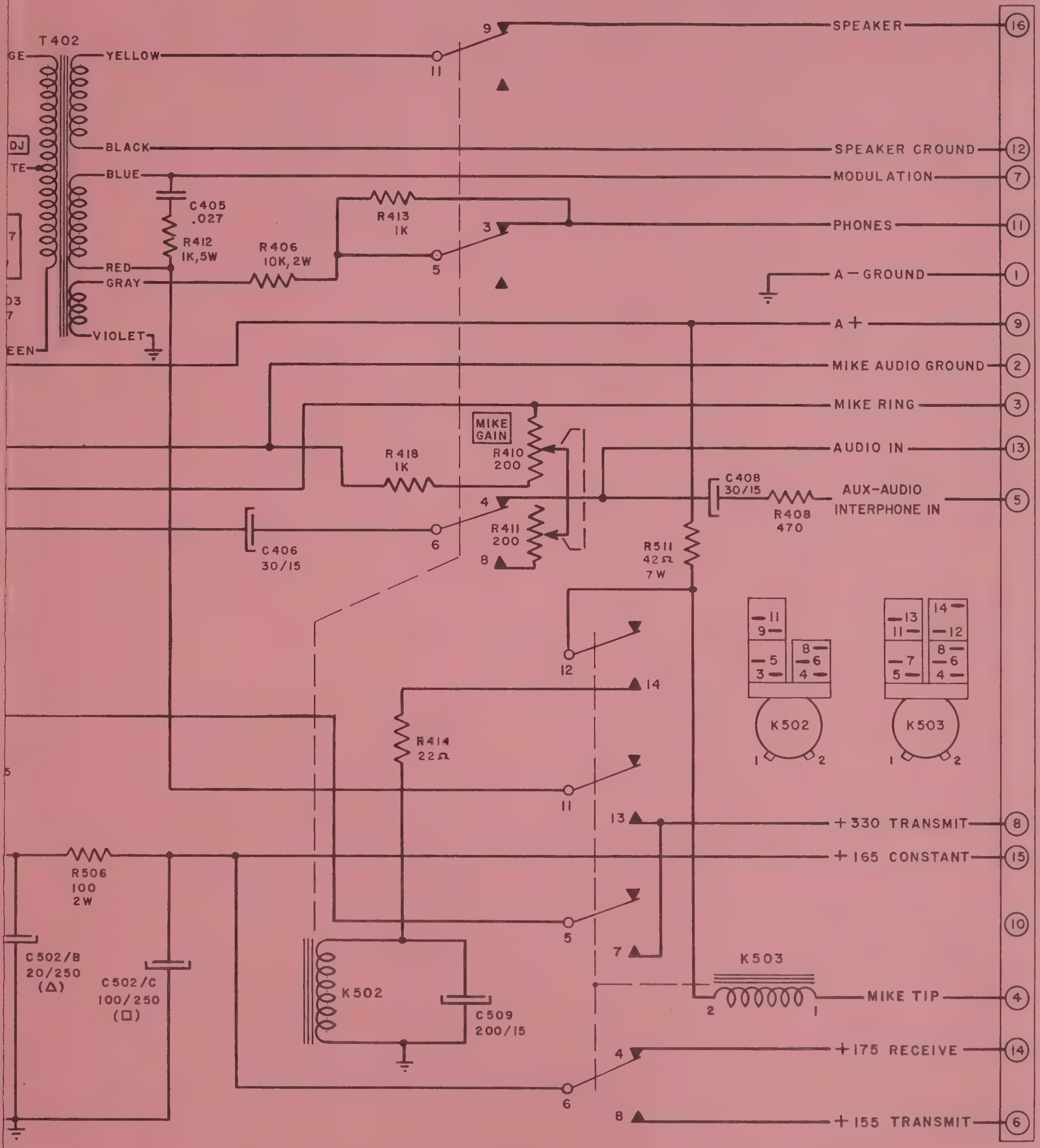
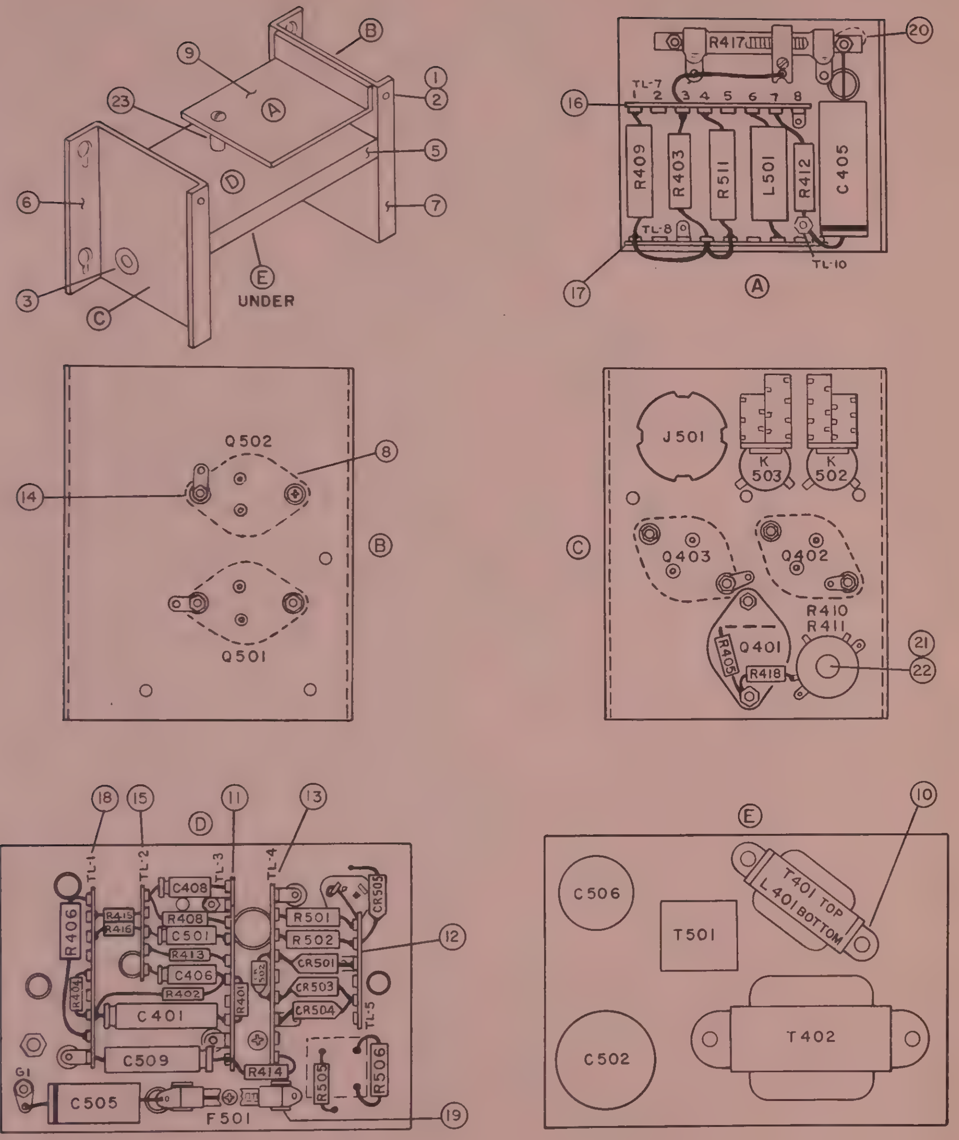

T402
GE
YELLOW
BLACK
DJ
TE
BLUE
RED
GRAY
VIOLET
EEN
C405
.027
R412
1K,5W
R406
10K, 2W
R413
1K
SPEAKER
SPEAKER GROUND
MODULATION
PHONES
A – GROUND
A +
MIKE AUDIO GROUND
MIKE RING
AUDIO IN
AUX-AUDIO
INTERPHONE IN
MIKE GAIN
R410
200
R418
1K
R411
200
C406
30/15
C408
30/15
R408
470
R511
42 Ω
7 W
K502
K503
R414
22 Ω
R506
100
2W
C502/B
20/250
(Δ)
C502/C
100/250
(□)
C509
200/15
MIKE TIP
+330 TRANSMIT
+165 CONSTANT
+175 RECEIVE
+155 TRANSMIT
16
12
7
11
1
9
2
3
13
5
8
15
10
4
14
6

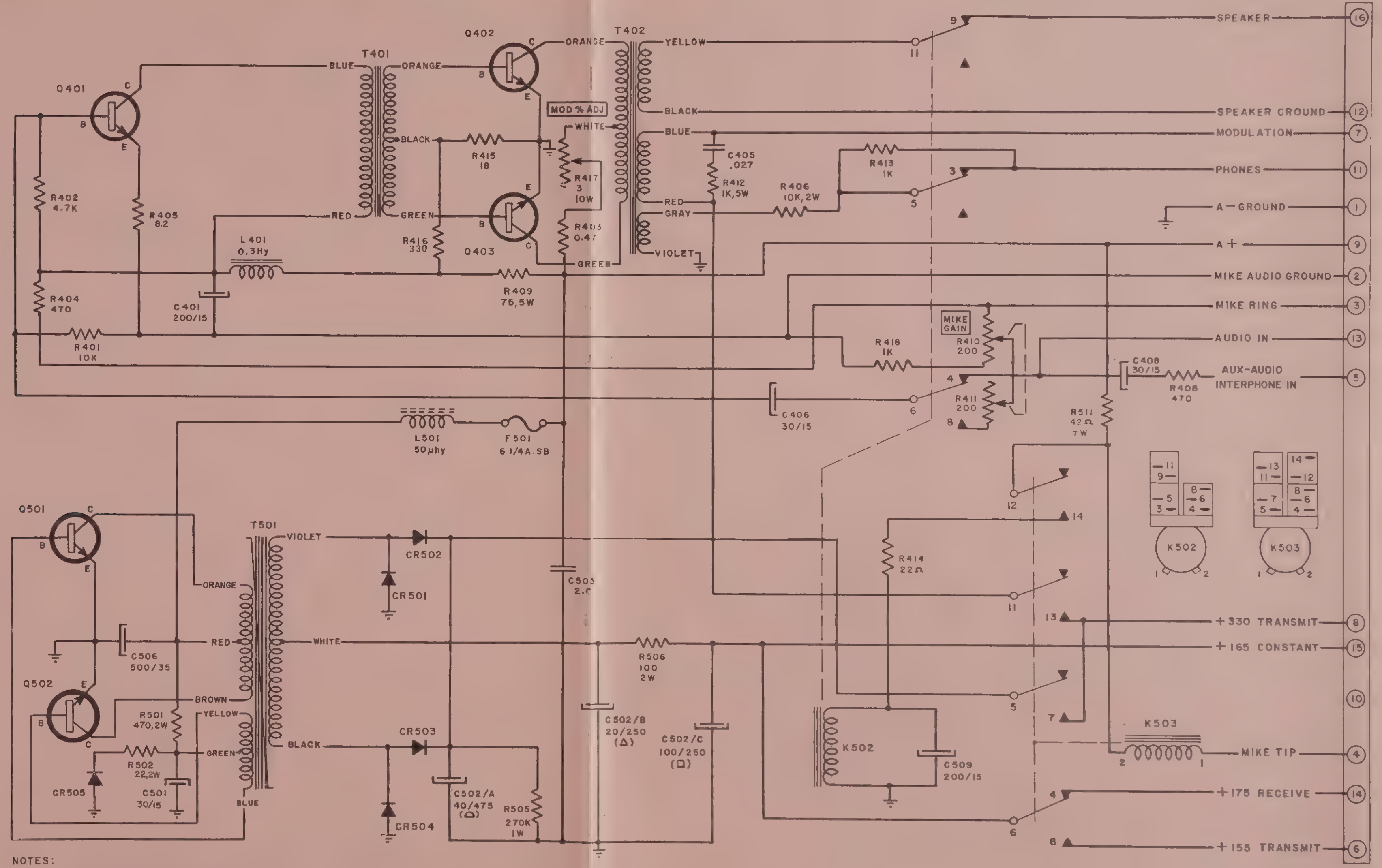
FIGURE 42. MODULATOR-POWER UNIT, (T24) MP-12AH-1
(Drawing and Schematic)


A
B
C
D
E
UNDER
R417
TL-7
TL-8
TL-10
R409
R403
R511
L501
R412
C405
Q502
Q501
J501
K503
K502
Q403
Q402
Q401
R410
R411
R405
R418
TL-1
TL-2
TL-3
TL-4
TL-5
C408
R415
R416
R408
C501
R413
C406
R402
C401
C509
C505
R406
R401
R414
F501
R501
R502
CR501
CR503
CR504
CR502
R505
R506
G1
C506
T501
T401 TOP
L401 BOTTOM
C502
T402
1
2
3
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

PARTS LOCATION DRAWING

TEST POINTS

See Fig. 40 for test points and values.


Q401
Q402
Q403
Q501
Q502
T401
T402
T501
BLUE
ORANGE
BLACK
RED
GREEN
YELLOW
WHITE
GRAY
VIOLET
BROWN
MOD % ADJ
R402 4.7K
R405 8.2
R404 470
R401 10K
R415 18
R416 330
R417 3 10W
R403 0.47
R409 75,5W
L401 0.3Hy
C401 200/15
C405 .027
R412 1K,5W
R406 10K,2W
R413 1K
MIKE GAIN
R410 200
R411 200
R418 1K
C406 30/15
C408 30/15
R408 470
R511 42Ω 7W
L501 50μhy
F501 6 1/4A.SB
CR502
CR501
C503 2.0
C506 500/35
R501 470,2W
R502 22,2W
C501 30/15
CR505
CR503
CR504
C502/A 40/475 (○)
R505 270K 1W
R506 100 2W
C502/B 20/250 (Δ)
C502/C 100/250 (□)
R414 22Ω
K502
K503
C509 200/15
SPEAKER
SPEAKER GROUND
MODULATION
PHONES
A − GROUND
A +
MIKE AUDIO GROUND
MIKE RING
AUDIO IN
AUX-AUDIO INTERPHONE IN
+330 TRANSMIT
+165 CONSTANT
MIKE TIP
+175 RECEIVE
+155 TRANSMIT
16
12
7
11
1
9
2
3
13
5
8
15
10
4
14
6

NOTES:

A- ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B- ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K = 1000, MEG = 1,000,000.

C- RELAYS SHOWN IN RECEIVE POSITION.

FIGURE 42. MODULATOR-POWER UNIT, (T24) MP-12AH-1
(Drawing and Schematic)

NOTE—This sheet may be placed at the front of the original Manual MM-211, with its Supplements No. 1, No. 2, and No. 3.

narco MARK-12
VHF Transceiver

with

NAVIGATION RECEIVER

and

T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL

FOR PANEL UNITS:

CN89-A. Original Manual thru page 58.
CNP89-A. Original Manual thru page 58.

CN89-B. Supplement No. 1, page 59, etc.
CNP89-B. Supplement No. 1, page 59, etc.

CN89-C & D. Supplement No. 2, page 71, etc.
CNP89-C & D. Supplement No. 2, page 71, etc.

CN89-E & F. Supplement No. 3, page 91, etc.
CNP89-E & F. Supplement No. 3, page 91, etc.

CN89-G. Supplement No. 4, page 117, etc.
CNP89-G. Supplement No. 4, page 117, etc.

FOR MODULATOR-POWER UNITS:

CNPA89-A. Original Manual thru page 58.
CNPB89-A. Original Manual thru page 58.

CNPA89-B. Supplement No. 2, page 71, etc.
CNPB89-B. Supplement No. 2, page 71, etc.

CNPA89-C & D. Supplement No. 3, page 91, etc.
CNPB89-C & D. Supplement No. 3, page 91, etc.

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

Printed in U.S.A.

MM-211 with
Supplement No. 4.

April, 1965

NOTE—This sheet may be placed at the front of the original Manual MM-211, with its Supplements No. 1 and No. 2.

narco

narco MARK-12
VHF Transceiver

with

NAVIGATION RECEIVER

and

T12MP-12 or T24MP-12 MODULATOR-POWER UNIT

MAINTENANCE MANUAL

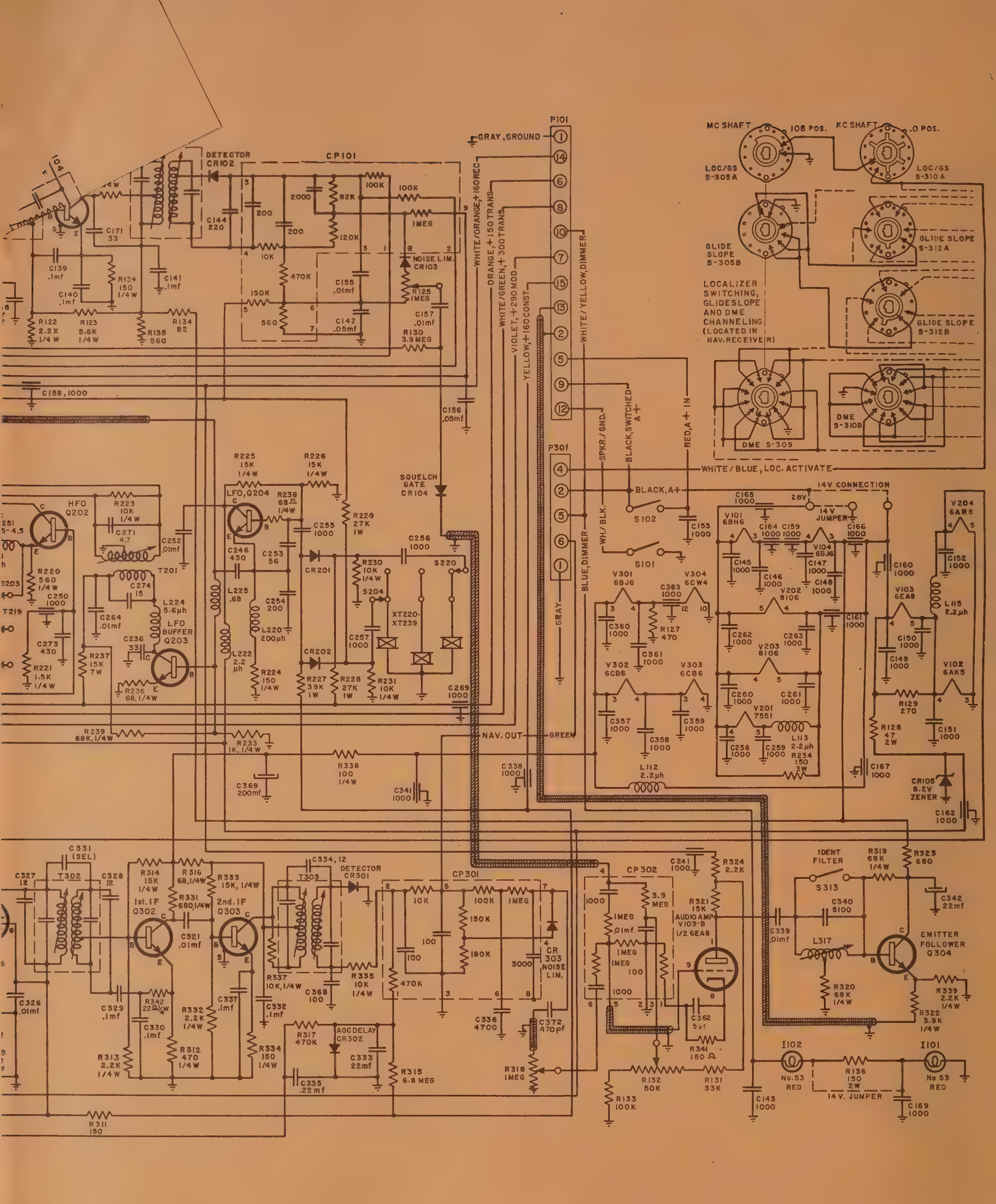
FOR PANEL UNITS:	FOR MODULATOR-POWER UNITS:
CN89-A. Original Manual thru page 58. CNP89-A. Original Manual thru page 58.	CNPA89-A. Original Manual thru page 58. CNPB89-A. Original Manual thru page 58.
CN89-B. Supplement No. 1, page 59, etc. CNP89-B. Supplement No. 1, page 59, etc.	
CN89-C & D. Supplement No. 2, page 71, etc. CNP89-C & D. Supplement No. 2, page 71, etc.	CNPA89-B. Supplement No. 2, page 71, etc. CNPB89-B. Supplement No. 2, page 71, etc.
CN89-E & F. Supplement No. 3, page 91, etc. CNP89-E & F. Supplement No. 3, page 91, etc.	CNPA89-C & D. Supplement No. 3, page 91, etc. CNPB89-C & D. Supplement No. 3, page 91, etc.

NATIONAL AERONAUTICAL CORPORATION
FORT WASHINGTON • PENNSYLVANIA

Printed in U.S.A.

MM-211

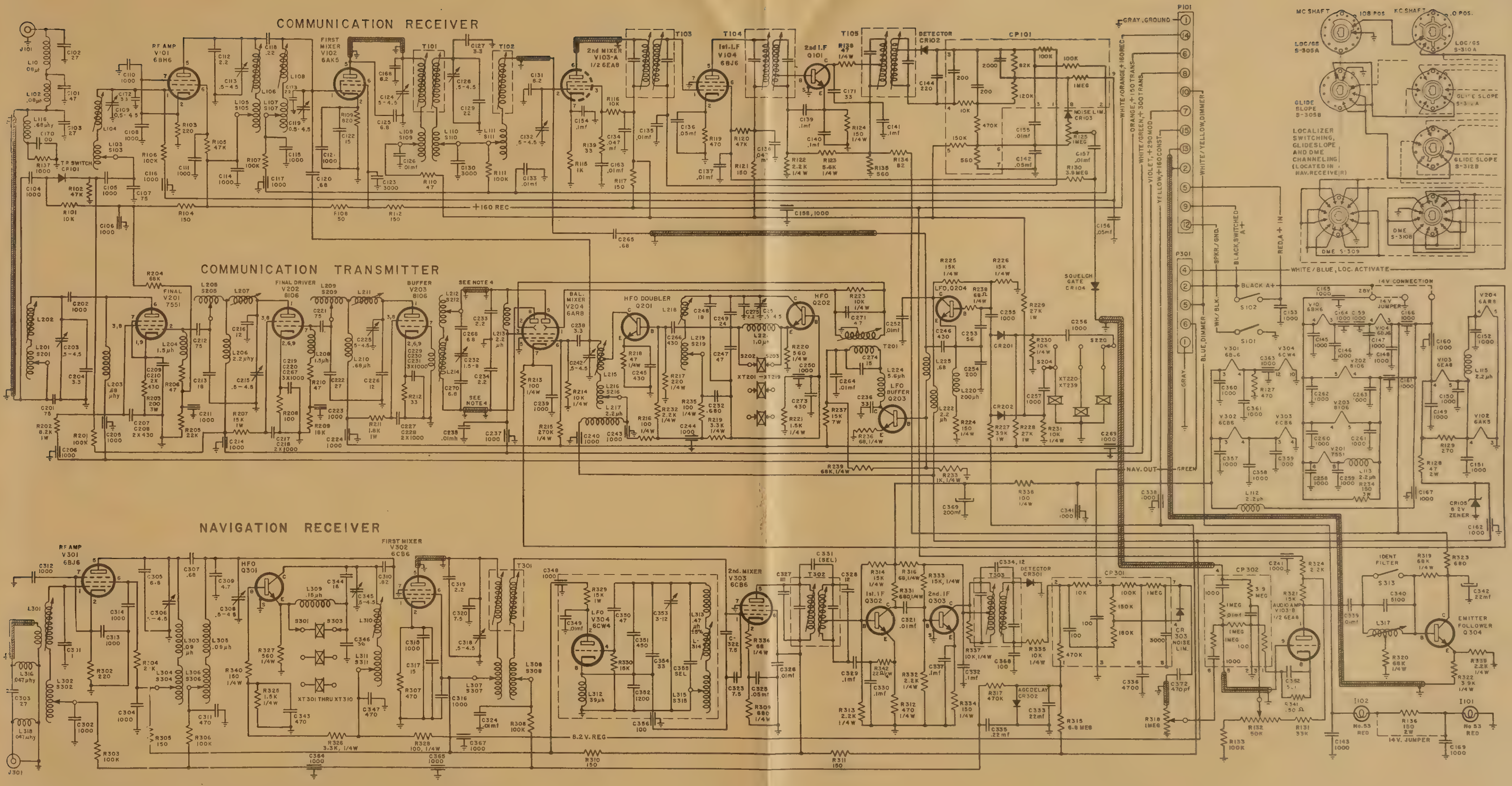
March, 1965



P101
GRAY, GROUND
DETECTOR CR102
CP101
C144 220
C171 33
C139 .1mf
C140 .1mf
R124 150 1/4W
C141 .1mf
R122 2.2K 1/4W
R123 5.6K 1/4W
R138 560
R134 82
2000
200
82K
100K
120K
10K
470K
150K
560
C155 .01mf
C142 .05mf
IMEG
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9 MEG
C158, 1000
C156 .05mf
WHITE/ORANGE, +160 REC
ORANGE, +150 TRANS
WHITE/GREEN, +300 TRANS
VIOLET, +290 MOD
YELLOW, +160 CONST
WHITE/YELLOW, DIMMER
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
GLIDE SLOPE S-312B
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-309
DME S-310B
SPKR./GND.
BLACK, SWITCHED A+
RED, A+ IN
P301
WHITE / BLUE, LOC. ACTIVATE
BLACK, A+
14V CONNECTION
28V
14V JUMPER
S102
C153 1000
WH./BLK.
S101
BLUE, DIMMER
GRAY
R225 15K 1/4W
R226 15K 1/4W
LFO, Q204
R238 68Ω 1/4W
R229 27K 1W
SQUELCH GATE CR104
HFO Q202
R223 10K 1/4W
C271 4.7
C252 .01mf
C255 1000
C256 1000
C246 430
C253 56
CR201
R230 10K 1/4W
S220
S204
XT220-XT239
T201
C274 15
L224 5.6µh
LFO BUFFER Q203
C264 .01mf
C250 1000
R220 560 1/4W
C273 430
R221 1.5K 1/4W
R237 15K 7W
C236 33
R236 68, 1/4W
L225 .68
L222 2.2 µh
C254 200
L220 200µh
R224 150 1/4W
CR202
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C257 1000
C269 1000
R239 68K, 1/4W
R233 1K, 1/4W
NAV. OUT
GREEN
R338 100 1/4W
C369 200mf
C341 1000
C338 1000
V301 6BJ6
V304 6CW4
C363 1000
C360 1000
R127 470
C361 1000
V302 6CB6
V303 6CB6
C357 1000
C358 1000
C359 1000
L112 2.2µh
C165 1000
V101 6BH6
C164 1000
C159 1000
V104 6BJ6
C166 1000
C145 1000
C146 1000
C147 1000
C148 1000
V202 8106
C262 1000
C263 1000
V203 8106
C161 1000
C260 1000
C261 1000
V201 7551
C258 1000
C259 1000
L113 2.2µh
R234 150 3W
C167 1000
V204 6AR8
C152 1000
C160 1000
V103 6EA8
L115 2.2µh
C150 1000
C149 1000
V102 6AK5
R129 270
R128 47 2W
C151 1000
CR105 8.2V ZENER
C162 1000
C331 (SEL)
C327 12
T302
C328 12
R314 15K 1/4W
R316 68, 1/4W
R333 15K, 1/4W
1st. IF Q302
R331 680, 1/4W
2nd. IF Q303
C321 .01mf
C334, 12
DETECTOR CR301
T303
CP301
10K
100K
IMEG
150K
100
180K
3000
CR 303 NOISE LIM.
R337 10K, 1/4W
C368 100
R335 10K 1/4W
C326 .01mf
C329 .1mf
R342 22Ω 1/4W
C330 .1mf
R332 2.2K 1/4W
C337 .1mf
C332 .1mf
R313 2.2K 1/4W
R312 470 1/4W
R334 150 1/4W
R317 470K
AGC DELAY CR302
C333 22mf
C335 .22mf
R315 6.8 MEG
C336 4700
C372 470pf
R318 IMEG
R311 150
C241 1000
R324 2.2K
CP302
3.9 MEG
R321 15K
AUDIO AMP V103-B 1/2 6EA8
C362 5uf
R341 150 Ω
R132 50K
R131 33K
R133 100K
IDENT FILTER
S313
R319 68K 1/4W
R323 680
C342 22mf
C340 5100
C339 .01mf
L317
EMITTER FOLLOWER Q304
R320 68K 1/4W
R339 2.2K 1/4W
R322 3.9K 1/4W
I102
No. 53 RED
R136 150 2W
14V. JUMPER
I101
No 53 RED
C143 1000
C169 1000

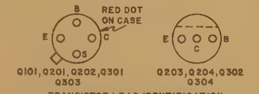
*See Figure 29 for test points and service data.

FIGURE 36. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B5


COMMUNICATION RECEIVER
COMMUNICATION TRANSMITTER
NAVIGATION RECEIVER
+160 REC
8.2 V. REG
NAV. OUT
SPEEDR
P101
P301
WHITE / BLUE, LOC. ACTIVATE
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
14V CONNECTION
14V. JUMPER
EMITTER FOLLOWER Q304

NOTES:

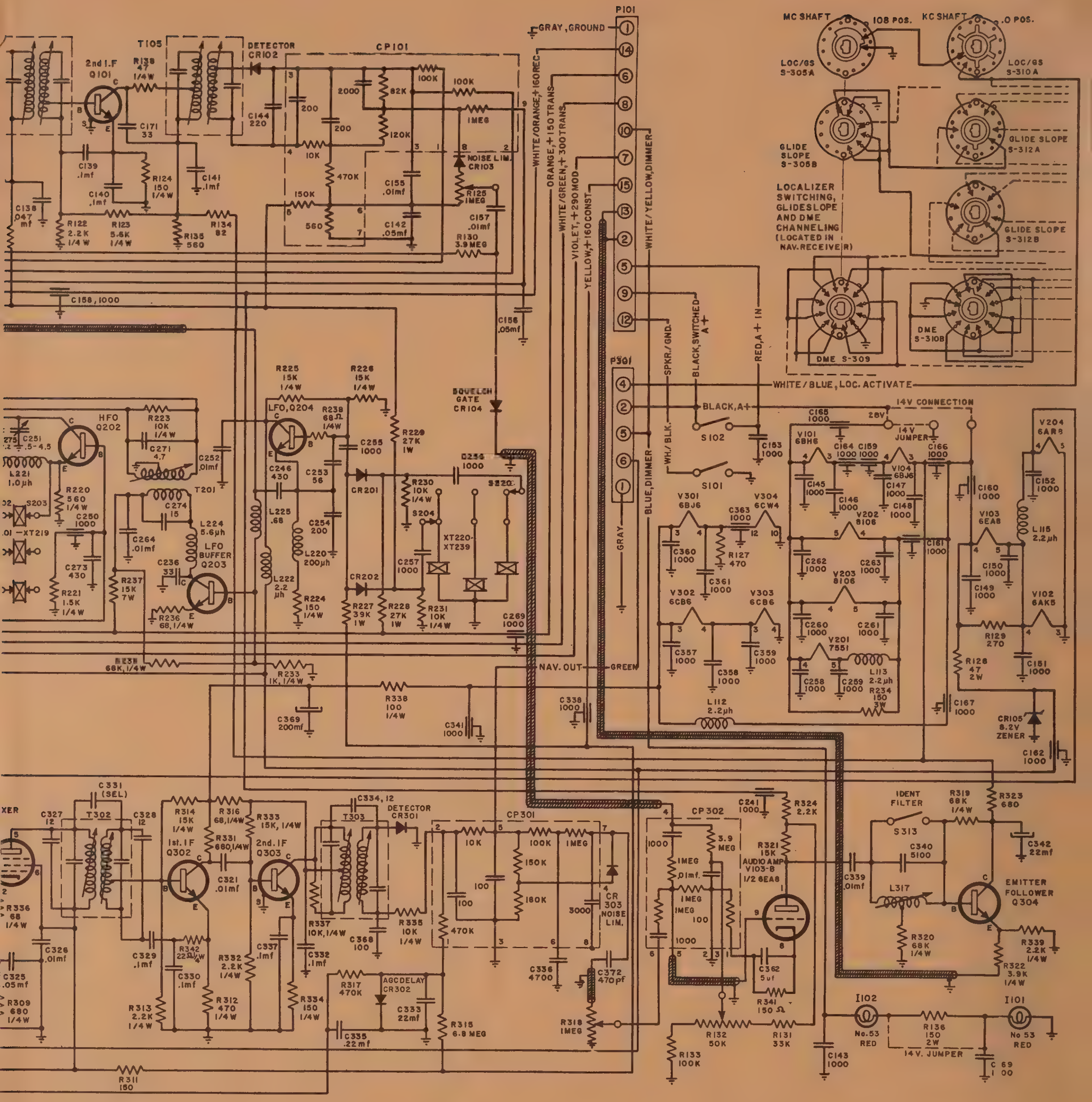
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 5 7/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.


B
RED DOT ON CASE
E
C
S
E
C
B
Q101, Q201, Q202, Q301 Q303
Q203, Q204, Q302 Q304

TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

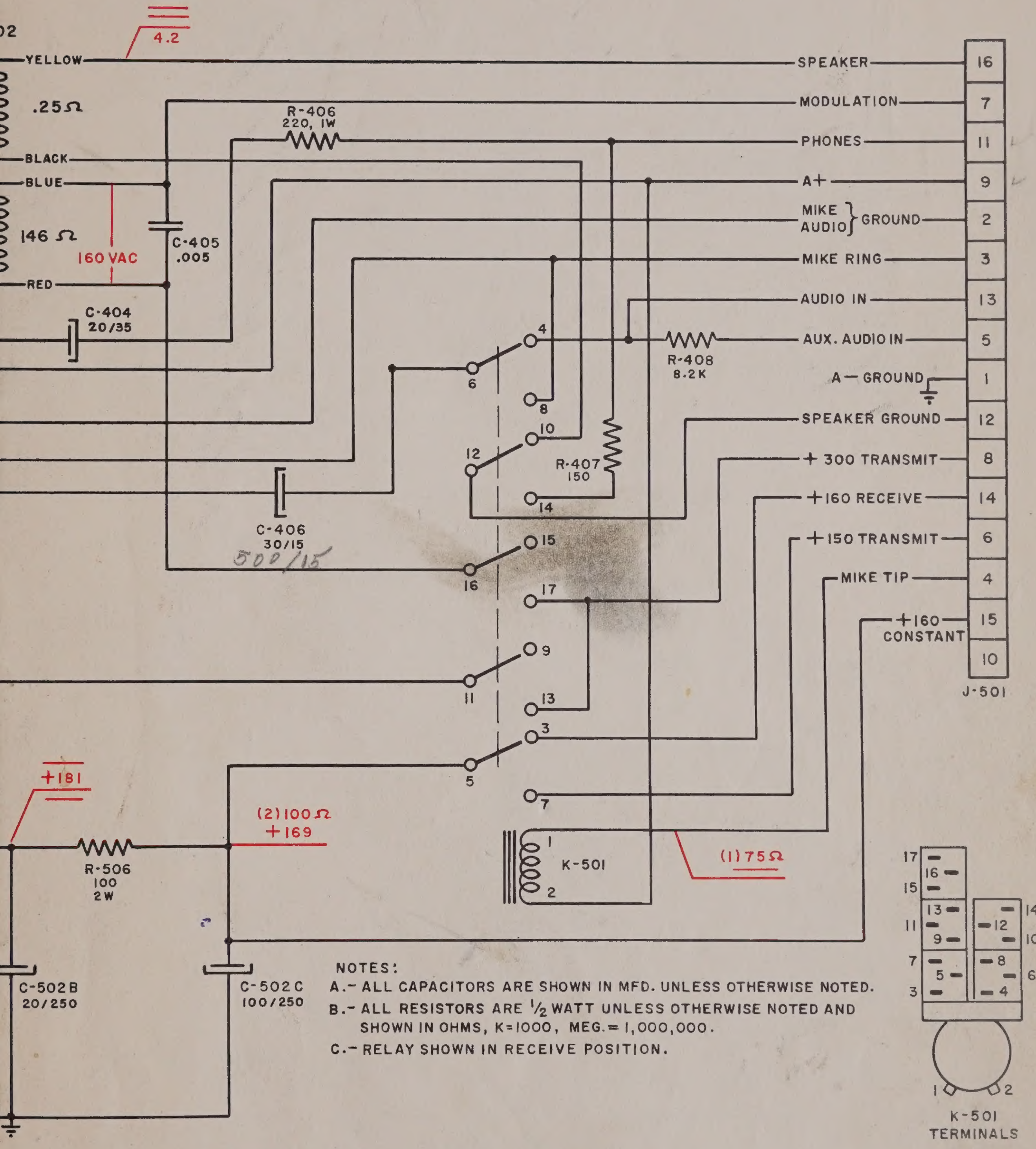
*See Figure 29 for test points and service data.

FIGURE 36. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B5


P101
GRAY, GROUND
WHITE/ORANGE, +160 REC
ORANGE, +150 TRANS
WHITE/GREEN, +300 TRANS
VIOLET, +290 MOD
YELLOW, +160 CONST
WHITE/YELLOW, DIMMER
MC SHAFT
108 POS.
KC SHAFT
.0 POS.
LOC/GS S-305A
LOC/GS S-310A
GLIDE SLOPE S-305B
GLIDE SLOPE S-312A
GLIDE SLOPE S-312B
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
DME S-309
DME S-310B
T105
2nd I.F Q101
R138 47 1/4W
C171 33
DETECTOR CR102
CP101
C144 220
C139 .1mf
C140 .1mf
R124 150 1/4W
C141 .1mf
C138 .047 mf
R122 2.2K 1/4W
R123 5.6K 1/4W
R135 560
R134 82
100K
100K
1MEG
82K
2000
200
200
120K
10K
470K
150K
560
C155 .01mf
C142 .05mf
NOISE LIM. CR103
R125 1MEG
C157 .01mf
R130 3.9 MEG
C158, 1000
C156 .05mf
SQUELCH GATE CR104
P301
SPKR./GND.
BLACK, SWITCHED A+
RED, A+ IN
WHITE/BLUE, LOC. ACTIVATE
BLACK, A+
14V CONNECTION
WH./BLK.
S102
C153 1000
S101
BLUE, DIMMER
GRAY
R225 15K 1/4W
R226 15K 1/4W
LFO, Q204
R239 68Ω 1/4W
R229 27K 1W
C255 1000
C256 1000
S220
HFO Q202
R223 10K 1/4W
C271 4.7
C251 .5-4.5
L221 1.0µh
R220 560 1/4W
S203
C250 1000
XT219
C252 .01mf
T201
C274 15
L224 5.6µh
LFO BUFFER Q203
C264 .01mf
C273 430
R221 1.5K 1/4W
R237 15K 7W
C236 33
R236 68, 1/4W
C246 430
C253 56
L225 .68
C254 200
L220 200µh
L222 2.2 µh
R224 150 1/4W
CR201
CR202
R230 10K 1/4W
S204
XT220-XT239
C257 1000
R227 39K 1W
R228 27K 1W
R231 10K 1/4W
C269 1000
R238 68K, 1/4W
R233 1K, 1/4W
NAV. OUT
GREEN
R338 100 1/4W
C369 200mf
C341 1000
C338 1000
V101 6BH6
C165 1000
28V
14V JUMPER
C164 1000
C159 1000
C166 1000
V104 6BJ6
C145 1000
C147 1000
C146 1000
C148 1000
V202 8106
V301 6BJ6
C363 1000
V304 6CW4
C360 1000
R127 470
C361 1000
C262 1000
C263 1000
V203 8106
C181 1000
V302 6CB6
V303 6CB6
C260 1000
C261 1000
V201 7551
C357 1000
C359 1000
C358 1000
C258 1000
C259 1000
L113 2.2µh
R234 150 3W
L112 2.2µh
V204 6AR8
C160 1000
C152 1000
V103 6EA8
L115 2.2µh
C150 1000
C149 1000
V102 6AK5
R129 270
R128 47 2W
C151 1000
C167 1000
CR105 8.2V ZENER
C162 1000
C331 (SEL)
XER
C327 12
T302
C328 12
R314 15K 1/4W
R316 68, 1/4W
R333 15K, 1/4W
R331 680, 1/4W
1st. I.F Q302
2nd. I.F Q303
C321 .01mf
C334, 12
T303
DETECTOR CR301
CP301
10K
100K
1MEG
150K
100
100
180K
470K
3000
CR 303 NOISE LIM.
R336 68 1/4W
C326 .01mf
C325 .05mf
R309 680 1/4W
C329 .1mf
R342 22Ω 1/4W
C330 .1mf
R313 2.2K 1/4W
R332 2.2K 1/4W
R312 470 1/4W
C337 .1mf
C332 .1mf
R334 150 1/4W
R337 10K, 1/4W
C368 100
R335 10K 1/4W
R317 470K
AGC DELAY CR302
C333 22mf
C335 .22mf
R315 6.8 MEG
C336 4700
C372 470pf
R318 1MEG
R311 150
CP302
C241 1000
R324 2.2K
1000
3.9 MEG
1MEG
.01mf
1MEG
1MEG
100
1000
R321 15K
AUDIO AMP V103-B 1/2 6EA8
C362 5uf
R341 150 Ω
R132 50K
R131 33K
R133 100K
C143 1000
IDENT FILTER
R319 68K 1/4W
R323 680
S313
C340 5100
C342 22mf
C339 .01mf
L317
EMITTER FOLLOWER Q304
R320 68K 1/4W
R339 2.2K 1/4W
R322 3.9K 1/4W
I102 No.53 RED
R136 150 2W
14V. JUMPER
I101 No 53 RED
C 69 1 00

*See Figure 29 for test points and service data.

FIGURE 37. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B6


4.2
YELLOW
SPEAKER
16
.25Ω
MODULATION
7
R-406
220, 1W
PHONES
11
BLACK
BLUE
A+
9
146 Ω
C-405
.005
160 VAC
MIKE AUDIO } GROUND
2
MIKE RING
3
RED
AUDIO IN
13
C-404
20/35
AUX. AUDIO IN
5
R-408
8.2K
A— GROUND
1
SPEAKER GROUND
12
+ 300 TRANSMIT
8
R-407
150
+160 RECEIVE
14
C-406
30/15
500/15
+150 TRANSMIT
6
MIKE TIP
4
+160 CONSTANT
15
10
J-501
4
6
8
10
12
14
15
16
17
9
11
13
3
5
7
+181
(2)100Ω
+169
R-506
100
2W
K-501
1
2
(1)75Ω
C-502B
20/250
C-502C
100/250
17
16
15
13
11
9
7
5
3
14
12
10
8
6
4
1
2
K-501
TERMINALS

NOTES:

A.– ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.

B.– ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.

C.– RELAY SHOWN IN RECEIVE POSITION.

TED.
ION
WER
R
ILLOSCOPE
ER OR

TEST DATA LINE

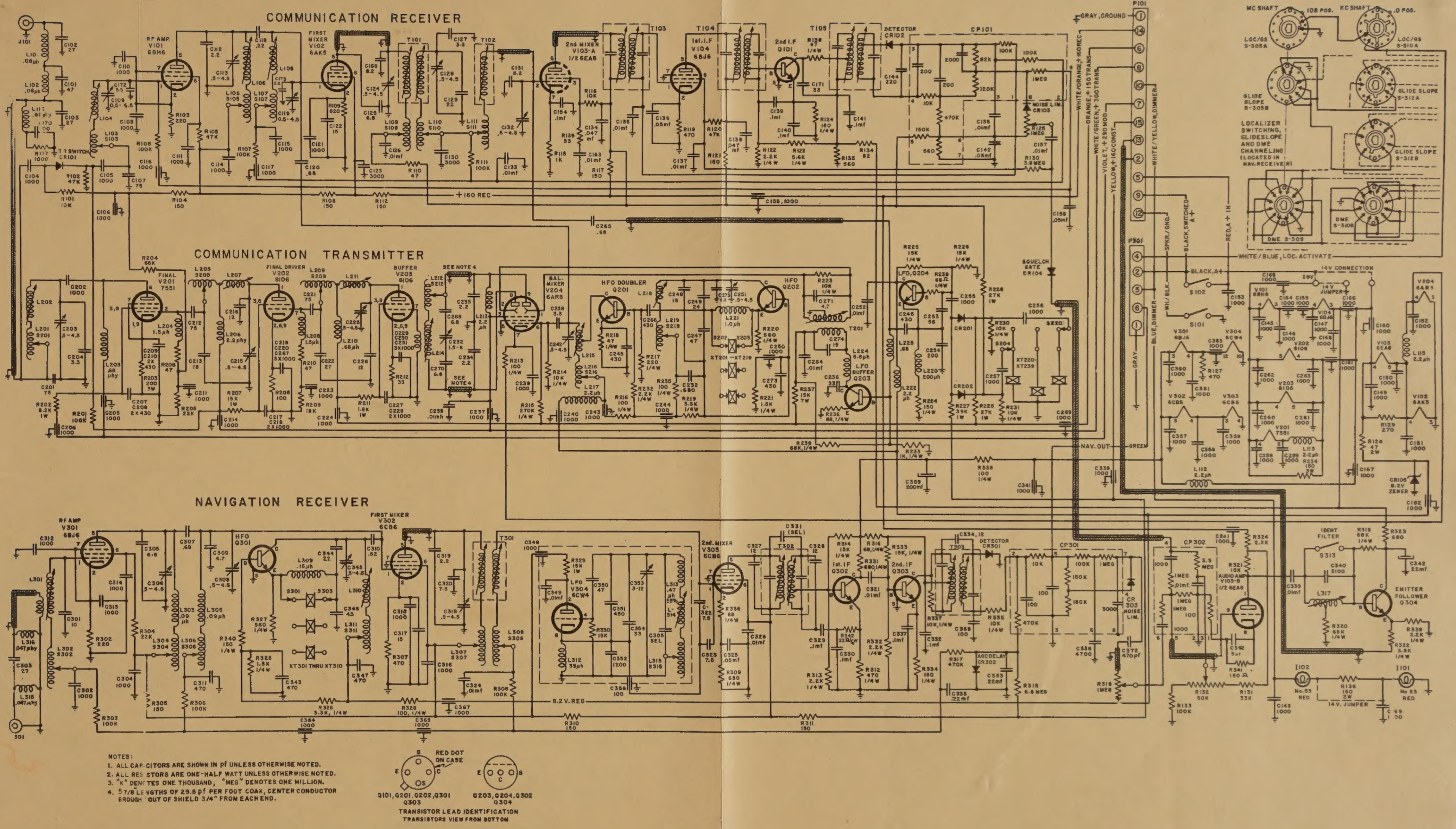
RESISTANCE

DC VOLTAGE AND POLARITY

AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Figure 12.

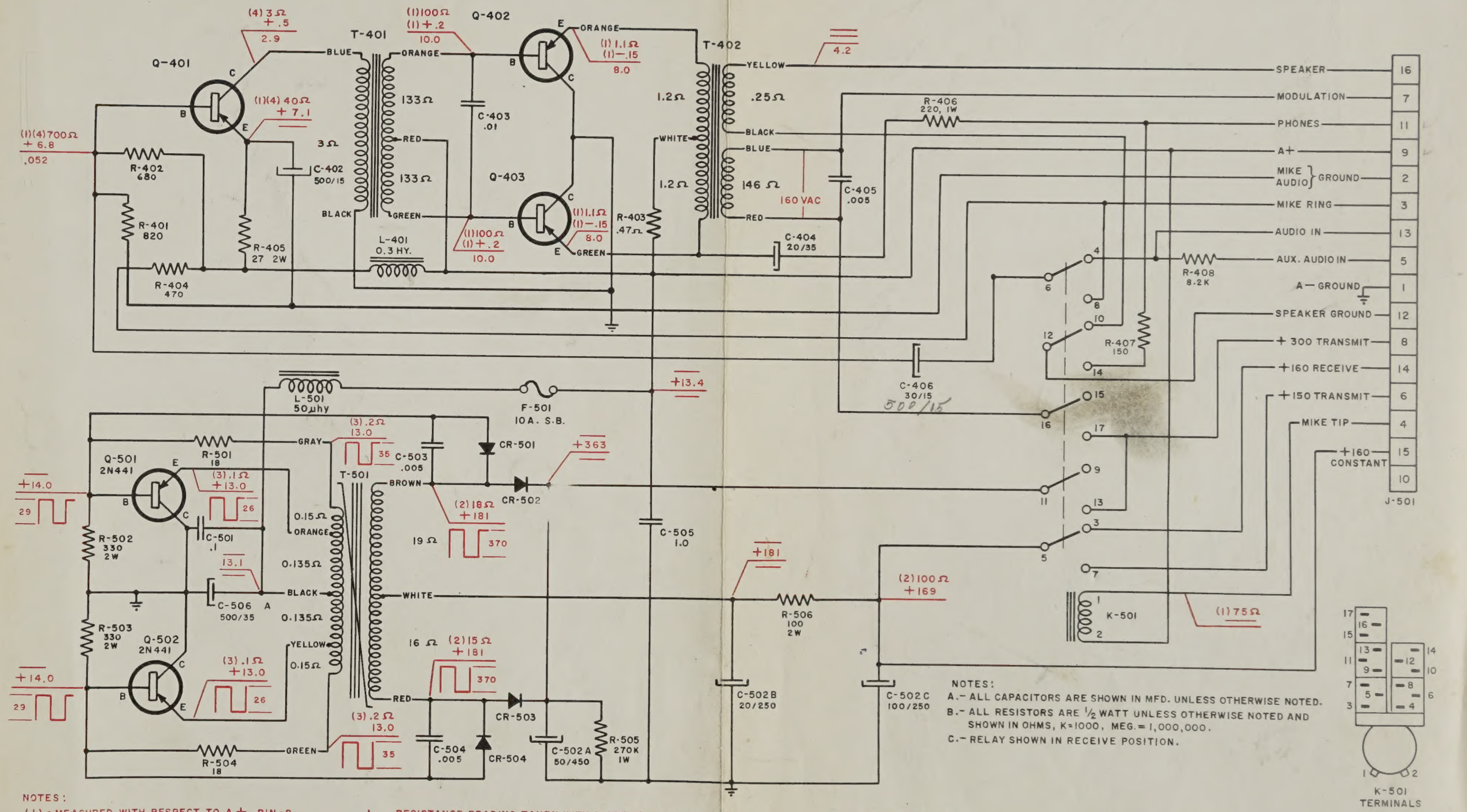
SCHEMATIC, MODULATOR POWER UNIT, T-12MP-12,
for *narco* Mark-12 operation on 12 Volts.
CNPA89-A


COMMUNICATION RECEIVER
RF AMP. V101 6BH6
FIRST MIXER V102 6AK5
2nd MIXER V103-A 1/2 6EA8
1st. I.F V104 6BJ6
2nd I.F Q101
DETECTOR CR102
CP101
J101
P101
COMMUNICATION TRANSMITTER
FINAL V201 7551
FINAL DRIVER V202 8106
BUFFER V203 8106
BAL. MIXER V204 6AR8
HFO DOUBLER Q201
HFO Q202
LFO BUFFER Q203
LFO Q204
SEE NOTE 4
SQUELCH GATE CR104
P301
NAVIGATION RECEIVER
RF AMP V301 6BJ6
HFO Q301
FIRST MIXER V302 6CB6
2nd. MIXER V303 6CB6
LFO V304 5CW4
1st. I.F Q302
2nd. I.F Q303
DETECTOR CR301
CP301
CP302
AUDIO AMP V103-B 1/2 6EA8
EMITTER FOLLOWER Q304
IDENT FILTER
J301
J102
J101
+160 REC
8.2 V. REG
NAV. OUT
MC SHAFT
KC SHAFT
LOCALIZER SWITCHING, GLIDESLOPE AND DME CHANNELING (LOCATED IN NAV. RECEIVER)
GLIDE SLOPE
DME
14V CORRECTION
14V. JUMPER
B
RED DOT ON CASE
E
C
S
Q101, Q201, Q202, Q301 Q303
Q203, Q204, Q302 Q304
TRANSISTOR LEAD IDENTIFICATION
TRANSISTORS VIEW FROM BOTTOM

NOTES:
1. ALL CAPACITORS ARE SHOWN IN pf UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE ONE-HALF WATT UNLESS OTHERWISE NOTED.
3. "K" DENOTES ONE THOUSAND, "MEG" DENOTES ONE MILLION.
4. 5 7/8" LENGTHS OF 29.5 pf PER FOOT COAX, CENTER CONDUCTOR BROUGHT OUT OF SHIELD 3/4" FROM EACH END.

*See Figure 29 for test points and service data.

FIGURE 37. NARCO AVIONICS MARK 12A, SCHEMATIC FOR CN-144-B6


Q-401
Q-402
Q-403
T-401
T-402
R-401 820
R-402 680
R-403 .47Ω
R-404 470
R-405 27 2W
R-406 220, 1W
R-407 150
R-408 8.2K
C-402 500/15
C-403 .01
C-404 20/35
C-405 .005
C-406 30/15
L-401 0.3 HY.
L-501 50μhy
F-501 10A. S.B.
Q-501 2N441
Q-502 2N441
R-501 18
R-502 330 2W
R-503 330 2W
R-504 18
R-505 270K 1W
R-506 100 2W
C-501 .1
C-503 .005
C-504 .005
C-505 1.0
C-506 A 500/35
C-502 A 50/450
C-502 B 20/250
C-502 C 100/250
CR-501
CR-502
CR-503
CR-504
T-501
K-501
SPEAKER
MODULATION
PHONES
A+
MIKE AUDIO GROUND
MIKE RING
AUDIO IN
AUX. AUDIO IN
A— GROUND
SPEAKER GROUND
+300 TRANSMIT
+160 RECEIVE
+150 TRANSMIT
MIKE TIP
+160 CONSTANT
J-501
K-501 TERMINALS

NOTES:
A.– ALL CAPACITORS ARE SHOWN IN MFD. UNLESS OTHERWISE NOTED.
B.– ALL RESISTORS ARE ½ WATT UNLESS OTHERWISE NOTED AND SHOWN IN OHMS, K=1000, MEG.= 1,000,000.
C.– RELAY SHOWN IN RECEIVE POSITION.

NOTES:
(1) - MEASURED WITH RESPECT TO A+, PIN-9.
(2) - MEASURED WITH RESPECT TO WHITE LEAD OF T-501.
(3) - MEASURED WITH RESPECT TO BLACK LEAD OF T-501.
(4) - MEASURED WITH Q-401 REMOVED.

RESISTANCE READING TAKEN WITH CONNECTOR DISCONNECTED.

OTHER READINGS ARE TAKEN WITH SET IN RECEIVE OPERATION AND 4.5 WATTS OF AUDIO OUT, WITH NORMAL 13.75 V. INTO POWER CABLE AT MARK-12. (AUDIO FREQUENCY 1000 CYCLES)

ALL DC MEASUREMENTS ARE WITH RCA VOLTOHMIST VTVM OR EQUIVALENT.

ALL WAVEFORMS ARE MEASURED WITH A DUMONT 401B OSCILLOSCOPE OR EQUIVALENT.

ALL AC MEASUREMENTS WITH BALLANTINE AC VOLTMETER OR EQUIVALENT.

TEST DATA LINE
RESISTANCE
DC VOLTAGE AND POLARITY
AC VOLTAGE OR
WAVE SHAPE & P-P VOLTAGE

Ref. T-02178-G 3-29-63

Figure 12.
SCHEMATIC, MODULATOR POWER UNIT, T-12MP-12,
for *narco* Mark-12 operation on 12 Volts.
CNPA89-A